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NOTES ON WESTERN RANGE FORBS

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NOTES ON WESTERN RANGE FORBS:

Equisetaceae through Fumariaceae

By

William A. Dayton
Formerly Chief, Division of Dendrology
and Range Forage Investigations, Forest Service

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NOTES ON WESTERN RANGE FORBS: EQUISETACEAE THROUGH FUMARIACEAE

By WILLIAM A. DAYTON

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INTRODUCTION

Annotated range plant collecting by the Forest Service began in 1907. These earliest collections, however, were deposited in the United States National Herbarium. In 1910 the Forest Service Herbarium in Washington, D.C., was started. This assemblage of annotated western range plant specimens is, almost without question, the largest in the country. It represents the work of well over a thousand employees and is of considerable importance taxonomically, but primarily it is a mine of information on the distribution, ecology, economic values, and life history of perhaps 10,000 or so range plants inhabiting the 11 Far Western States. The serial numbering of these plants, now reaching about 125,000 specimens, started August 4, 1911, there being no record of those submitted prior to that date.

Economic notes were prepared, chiefly by the writer, for about 3,000 species, mostly on cards. In addition, during reconnaissance for mapping vegetation of certain national forests of special grazing importance, some members of the crews also annotated range plants on cards and prepared palatability tables. These manuscript notes and data on collection forms of Forest Service Herbarium plant specimens, as well as personal observations and research, furnish the basis for this handbook.

Range vegetation is customarily divided into four categories: grasses, grasslike plants (primarily sedges and rushes), forbs (weeds),[2] and shrubs (woody plants). Among these, forbs are by

[1]Mr. Dayton retired in December 1955 and served from then until his death on October 20, 1958, as a Collaborator with the Forest Service.

[2]Unfortunately, in dealing with this group of plants we enter the field of semantics. The western stockman's term "weed" covers nongrasslike herbs whether palatable or nonpalatable, injurious or harmless, desirable or undesirable. And, from an etymological standpoint, "forb" is objectionable. The Greek from which it is anglicized means food—especially forage or fodder, and applies primarily to grasses; moreover, its widened usage to cover plants which do not produce forage and may even be harmful, is naturally quite arbitrary. Despite all this, the term is now widely sanctioned by usage.

far the most numerous. Unlike the other three groups, they seldom dominate other vegetation, but rather are found as admixtures in grasslands or in the understories of forest and brush types. Exceptions, of course, are found in temporary associations, such as the first and second "weed stages," as aftermath of destructive grazing and erosion, described by Sampson *(177)*.[3]

Of all plant families, grasses admittedly are the most important for range forage, and their poisonous or otherwise undesirable species are relatively few. Forbs (range weeds), on the other hand, vary enormously in palatability, and they embrace a large majority of our poisonous plants. However, because of their great number, diversity, and ubiquity, they are of great importance to all kinds of livestock and herbivorous wildlife but perhaps especially so to sheep. The genera and species annotated for the various families included here were selected on the basis of importance (for grazing, as poisonous plants, etc.); interest (peculiarities, miscellaneous values); and commonness and abundance. Because only about one-fourth of the range forbs in the 11 Far Western States are covered here, it is hoped that someone will carry this work to completion.

Although this handbook is concerned primarily with vascular plants, the nonvascular algae, fungi, lichens, mosses, and liverworts are perhaps worthy of mention. Certain algae, such as species of the genera ***Nostoc*** and ***Anabaena***, often cause bad odors and taste in water and are frequently, but apparently incorrectly *(151, p. 186)*, accused of poisoning livestock. Some parasitic fungi, such as rusts and smuts, may be injurious to livestock, as is moldy hay. Squirrels and other wildlife are fond of mushrooms and other edible fungi, and cattle and other livestock sometimes crop mushrooms (***Agaricus* spp.**, et al.). The fondness of swine for truffles is well known. The writer is not aware of any case where domestic livestock have voluntarily eaten amanitas and other toxic fungi.

In the tundras of the Arctic, **reindeermoss [*Cladonia rangiferina* (L.) Web.]** and related species are noted as highly important forage for reindeer, caribou, muskox, and other native herbivores *(199)*, and in Scandinavia these small shrublike lichens are harvested for cattle *(122, 150)*. Bearded tree lichens, such as species of ***Usnea*** and ***Alectoria***, when abundant and dry, may be serious forest fire hazards. One of the very few parmelias growing on bare soil, in the Rocky Mountains east to Nebraska and North Dakota, is ***Parmelia molliuscula* Ach.** This gray-green lichen blows into drifts and, on winter range where better feed is unavailable or scarce, it may be eaten by livestock, especially sheep and cattle; it causes paralysis of the hind legs *(15)*.

HORSETAIL FAMILY (EQUISETACEAE)

This is a monotypic family, now represented solely by the genus *Equisetum*, although in the Carboniferous epoch the family was richly developed, vast forests of tree calamites entering into the

[3]Italic numbers in parentheses refer to Literature Cited, p. 224.

composition of our coalbeds of today. The generic name *Equisetum*, while perhaps not classical Latin, is unquestionably ancient; it derives from Latin *equus* (horse) + *seta* (bristle, or strong, coarse hair, horsehair being *seta equina)*. The famous pre-Linnean botanist Tournefort, in his Institutiones Rei Herbariae, says that the name derives "a foliorum forma" (i. e., the form of the leaves); presumably the numerous fine branches are referred to.

Horsetail *(Equisetum)*

This genus, often also called scouring-rush, consists of about 25 species, mostly occupying wet or moist sites, widely distributed in the Northern Hemisphere; a few species, however, are more localized. Horsetails are somewhat rushlike plants, perennial from dark-colored, extensively creeping and branching rootstocks (rhizomes). The aerial stems, mostly erect, may be annual or perennial; they are cylindrical, fluted and silicious, with solid joints (nodes) and mostly hollow internodes, often with whorled branches at the nodes. The small leaves are united lengthwise into sheathlike structures ("sheaths") at the stemjoints, or nodes, their tips ("teeth") fused together or free. The minute fruiting spores are provided with four spiral ribbonlike "elaters" which assist in their propulsion when ripe, and are produced in small, stalked, shieldlike *sporangia* borne in conelike fruiting spikes at the tips of the fertile stems.

Horsetail species are largely distinguished by such characters as size and robustness of stems, likeness or unlikeness of sterile and fertile stems, number of angles or grooves in stems, color and persistence of aerial stems, relative size of stem cavities, and number of leaves at a node. Horsetails, as a rule, are not highly regarded as range forage but frequently may be an important constituent in wild hay. When fed in large quantities, however, a number of the species are known to cause scours and sometimes paralysis and death. Horses are the class of stock most usually affected.

Field horsetail *(Equisetum arvense* L.), as the scientific name *arvense* (of fields) indicates, inhabits fields, old meadows, roadsides, railroad embankments and the like, and ranges from Greenland and Newfoundland to Alaska and south to California, New Mexico, northeastern Kansas, Kentucky, and North Carolina; also Europe and Asia. The plant is highly variable; its aerial stems are annual, the sterile and fertile stems differing so markedly as to have the appearance of belonging to two different plants. The short-lived fertile stems appear early in the spring before the sterile stems; they are pale brown or flesh color, usually unbranched, seldom more than about 10 inches high, bearing at the tip a single narrow fruiting cone; the sheaths are 8 to 12 toothed.

The bright green, slender sterile stems are longitudinally 6 to 14 furrowed, from 4 inches to 2 feet (rarely 3 feet) high; the loose whitish sheaths are chaffy and about 12 toothed; the numerous branches are sharply 4 (occasionally 3) angled, with 4-toothed sheaths. As the fertile stems wither and disappear soon after the spores are shed, the sterile stage is the aspect usually

seen in the field. The plant is often common in sandy soils, particularly where there is a good supply of moisture at least during most of the growing season. It is seldom eaten on the range except accidentally as when mixed with hay.

Chesnut and Wilcox *(39, p. 134)* refer to the plant's reputation of being poisonous to horses but indicate that no cases of poisoning have been reported of it from Montana where it is sometimes common. They state that "the plant, if deleterious, is evidently so only on account of its harsh scouring action in the mouth and intestinal tract." Long *(123, pp. 84–85)* reviews considerable literature on this plant and cites authorities both to the effect that the green plant appears to be harmless and also that horses can be fatally poisoned by it. A case of sheep poisoning was reported from a national forest in Wyoming in which this species was suspected. Apparently there is room for further study of this common plant.

Meadow horsetail ***(Equisetum pratense* Ehrh.)**—*pratense* means of meadows—is closely related and rather similar to the preceding species. It is characteristic of moist meadows, rich woods and the like, often in limestone formations, widely distributed from Newfoundland and New Brunswick to Alaska and south to Montana, Colorado, North Dakota, Iowa, Michigan, and New Jersey; also in Europe and Asia. Compared with field horsetail the paler green, more slender mostly 3- (instead of 4-) angled stems have the hollow central part much narrower (about a sixth of the stem diameter), the internodes rougher, with 3 rows of small silicious bristles on each of the 8 to 20 ridges, the teeth of the branch sheaths shortly triangular (deltoid) instead of lance shaped. The fertile stems are more persistent, becoming branched with age, and not soon withering except at the top. The palatability to range livestock is negligible to low; there appears to be no record of its poisoning range animals.

Another related species is **marsh horsetail** ***(Equisetum palustre* L.)**, a boreal plant of circumpolar distribution, occurring in Europe, Asia and, in North America, from Newfoundland and Labrador to Alaska and south to Oregon, Wyoming, Nebraska, Minnesota, Illinois, and Pennsylvania, in marshes (as the Latin name *palustre* indicates), wet woods, along shores, etc., often in limestone areas. Both fertile and sterile stems are alike, green, slender, conspicuously 5 to 10 angled and grooved, with very small central cavity, and loose dilated sheaths with dark, usually white-margined teeth.

Perhaps marsh horsetail has been more thoroughly studied from the toxicological standpoint than any other species of the genus. Long *(123)* states that European investigations have shown that the young shoots, which incidentally contain the least silica, are much more poisonous than the old stems, and that a dangerous nerve-poisoning alkaloid, *equisetin,* has been isolated from this particular species. He further states that young animals appear to succumb sooner than older ones; that grain-fed animals are more resistant than others, and that the milk yield of cattle appears

to be affected by the plant, loss in both quality and quantity being noted.

Five other range species of this genus worthy of mention because of local abundance, though probably negligible or nearly so as forage except in cases of overstocking or where eaten in hay, are as follows:

1. **Common scouring-rush** ***(Equisetum hyemale* L.)**, the species name signifying "winter" because of the evergreen habit, usually occurs on moist sandy sites almost throughout North America and in Europe and Asia. Fertile and sterile stems are alike, mostly unbranched, about 18 to 40 ridged, 1 to 4 feet high, with narrow central cavities, the fruiting terminal cones tipped by a firm dark point; the relatively short sheaths usually have two black bands, the teeth jointed and usually deciduous. This, like the species listed next, was formerly much used for scouring floors.

2. Closely related to *Equisetum hymale,* and by many considered a large variety of it, is **stout** (or giant) **scouring-rush [*E. praealtum Raf.*,** syns. *E. robustum* A. Br., *E. hyemale* var. *robustum* (A. Br.) A. A. Eaton, and perhaps *E. hyemale* var. *affine* (Engelm.) A. A. Eaton]. This grows in colonies and has stout erect stems often 5 to 10 feet high and 1 inch thick and ranges from Newfoundland and Quebec to southern Alaska and south to California, Florida, and central Mexico, also in Asia. Pammel *(151, pp. 323–325)* describes poisoning of cattle and horses by this plant under the name *equisetosis.* Some writers retain the original spelling *prealtum* of Rafinesque; evidently *praealtum,* indicating something comparatively taller, was intended.

3. Another closely related species is **smooth horsetail** ***(Equisetum laevigatum* A. Br.)**, growing in about neutral soils from Ontario to British Columbia, and south to California, Texas, Illinois, and Virginia; also in Mexico and Central America. It has relatively smooth stems of one type, 10 inches to 3½ feet tall, the sheaths widened upwards, mostly with a single black band, the teeth soon falling; the fruiting cones are sharp pointed.

4. **Kansas horsetail** ***(Equisetum kansanum* Schaffn.)** is considered by some confluent with *E. laevigatum.* It has soft weak rather smooth stems with relatively large cavities, growing up to about 3½ feet high, the fruiting cones blunt and rounded, and occurs mostly in sandy soils from Michigan to southern British Columbia and south to California, Texas, and into northern Mexico.

5. **Variegated horsetail** ***(Equisetum variegatum* Schleich.)**, with slender stems 8 to 16 inches tall, occupies neutral to slightly alkaline sites from Greenland, Newfoundland and Labrador to Alaska and south to Oregon, Nevada, Colorado, Nebraska, Wisconsin, Illinois, and Pennsylvania; also in Europe and Asia. The sheath teeth are whitish or white margined.

CLUBMOSS FAMILY (LYCOPODIACEAE)

Unless one includes in this family, as a few botanists do, the small family Psilotaceae (represented in Florida and Australia),

and except for a rare Australian species of another widely distributed genus, Lycopodiaceae consists only of the clubmoss genus *(Lycopodium)*,[4] with about 600 species chiefly found in tropical mountains. *Lycopodium* is one of the oldest of all living plant genera, extending backwards in an unbroken line almost as far as the Palaeozoic. It is related to the large fossil lycopod tree genus *Lepidodendron*, the most important contributor to the coal deposits of southern Illinois, an aftermath of carboniferous forests of 300 million years ago or so *(5)*.

About 15 species of clubmosses occur in the United States, at least 6 or 7 of which have well-marked varieties. They are perennial evergreen somewhat mosslike plants, with underground or trailing and also erect 2-branching stems, the true roots produced from the underside of the stems which are in contact with the ground. The leaves are small, crowded, mostly 4 to 10 ranked. The reproductive spores are in spore-cases *(sporangia)* borne in the axils of special leaves *(sporophylls)* which are usually rather different from the rest of the foliage and often borne in terminal cone-like appendages. The species are distinguished by habit, leaf characters and number of leaf ranks, presence or absence of sporophyll cones, etc.

The majority of our native clubmosses occur also in the Far Western States, often in moist or dry woods. Their palatability to domestic livestock is nil. Some of the species, particularly **groundcedar *(Lycopodium complanatum* L., and its variety *flabelliforme* Fern.)**, a boreal and eastern species getting into Washington, Idaho, and Montana, and **groundpine *(L. obscurum* L.)**, another boreal and Asiatic species getting as far south as some of the Eastern States and the Northwestern States, both often called "crowfoot," are in much demand as Christmas decorations. Practically all the species are also in ornamental cultivation. Clubmoss spores are often used as an easy means of comparative measurement on a microscope slide; they have a fairly uniform diameter of about 40 microns *(211)*. A subject worthy of further study is the possible relationship of the highly flammable spores of clubmosses to some forest fires of obscure origin.

Runningpine *(Lycopodium clavatum* L.), with a somewhat similar distribution to that of the two species mentioned above, was formerly an important drug plant, the light oily sulfur-yellow powdery 4-sided spores (known as "vegetable sulfur") being used as a dusting powder for infants, a diuretic, etc. But this medicinal use according to the latest edition of the United States Dispensatory *(147)* "has fallen into complete desuetude." The spores were formerly used also for flashlight powders, and the Chinese used those of some of their native species in the manufacture of fireworks. The spores of *L. clavatum* are still in commercial use in pharmacy in pill manufacture for facilitating rolling and for preventing adhesion *(216)*.

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[4]The generic name (from Greek *lukos*, wolf, + *pous, podos*, foot) corresponds with another common name of clubmosses, "wolffoot."

POLYPODY FAMILY (POLYPODIACEAE)

Unless, as some botanists prefer, two other groups—the woodfern (Aspidiaceae) and brake (Pteridaceae) families—are separated from it, the polypody family of ferns,[5] embracing about 200 genera and an estimated 5,600 to 7,000 species, largely tropical, is much the largest family in the great plant division Pteridophyta, ferns and fern allies. A great majority of Western United States ferns belong to Polypodiaceae, where about 22 genera and 110 species of this family occur, the number of genera and species increasing toward the south.

As in all the higher, or vascular spore-bearing plants (ferns, horsetails, clubmosses, etc.) members of this family are characterized by what is commonly called "alternation of generations," i.e., each species exists in two entirely different phases, the sexual stage *(prothallus,* or *gametophyte)* and the asexual stage *(sporophyte).* The conspicuous sporophyte stage is the familiar "fern" plant of everyday life, the one ordinarily described in the manuals and other literature. The spores, or powdery fruiting bodies of the sporophyte, give rise on germination to the gametophyte, or sexual stage, and are borne in rounded organs called *sporangia;* these sporangia in the Polypodiaceae are stalked, assembled in clusters *(sori)* of characteristic shapes, the sori frequently with a more or less lidlike covering, the *indusium.*

All United States Polypodiaceae are herbaceous, perennial from creeping or erect, hairy or scaly rootstocks. Their fronds, or leaves, come up from the ground in the spring coiled like a bishop's crosier; they are occasionally simple and entire but are usually more or less cut or divided and are frequently simply or compoundly pinnate or pinnatifid; fertile (spore-bearing) and sterile leaves may be similar or unlike. As a rule these plants are not important as forage plants, at least for domestic livestock. Bracken, annotated later, is one of the very few range ferns that is at once of good size, widely distributed, common, and abundant.

Maidenhair ***(Adiantum pedatum*** **L.),** a well-known graceful fern, occurs in every province of Canada and in every State of the United States except for the southern fringe of States from Florida to Texas and Arizona. From the Rocky Mountain region westward it chiefly occurs in the variety ***aleuticum*** **Rupr.,** the type of which came from the Aleutian Islands. The species is also found in Siberia, China, Japan, northern India, and parts of colder and temperate Asia.

The plant is perennial from a slender creeping chaffy much-rooting rootstock, the fronds or leaves 8 to 20 inches high, forking at the summit of the shiny brownish or blackish leafstalk *(stipe),* the downcurving branches bearing on one side several slender spreading pinnate divisions, the ultimate "leaflets" *(pinnules)*

[5]The word fern in various spellings (such as fern, ferns, fearne, fern, and varn) is the basis of an almost innumerable number of place and family names. With Latin *pinna* and Sanskrit *parna* it is cognate with *feather,* featherlike leaves being a characteristic feature of this family.

numerous, short stalked, obliquely triangular-oblong, entire on the lower margin, cleft and fruiting on the upper margin. The Aleutian or western variety differs from the typical form in its stouter suberect rootstock, fewer narrower and more erect leaf divisions *(pinnae)*, and more deeply cleft pinnules, or "leaflets."

The plant is always local in occurrence, where it may be plentiful, usually occurring in moist rich shaded wooded sites, frequently on or near streams, from near sea level. The forage value to domestic livestock is negligible or slight; it is reported to be eaten by mountain goats in winter to some extent. It is prized as an ornamental in cultivation.

Malefern [*Dryopteris filix-mas* (L.) Schott, syn. *Aspidium filix-mas* (L.) Swartz], a large plant up to 4 feet high, ranges from Greenland, Newfoundland, and Labrador to Alaska and south to California, Mexico, western Texas, western Oklahoma, South Dakota, northern Michigan, Ontario, and Vermont; also in Europe, Asia, and north Africa, mostly in woods, upland pastures and rocky slopes, chiefly in limestone or slatey sites. The rootstocks are thick and more or less erect; the somewhat leathery fronds are more or less twice pinnate, 1 to 3 feet long, and 6 to 11 inches wide; the fruiting dots *(sori)* are rounded kidney shape and borne near the midveins.

The plant ordinarily is not touched by domestic livestock; it is undoubtedly more or less poisonous, the active principle appearing to be filicic acid *(28,123)*. Malefern is, however, an important medicinal plant, the rootstocks *(rhizomes)* and stalk *(stipe)* bases being a vermifuge and a standard remedy for tapeworm, for which purpose the closely related **leather woodfern [*Dryopteris marginalis* (L.) A. Gray]**, sometimes called marginal shieldfern, of southern Canada and the Eastern States as far west as Arkansas and Oklahoma, is often substituted. A common but useless adulterant of this drug is the rootstock of **ladyfern [*Athyrium filix-femina* (L.) Roth]**, a delicate fern growing almost throughout Canada and the United States as well as in temperate Europe and Asia, and reported to be fair elk and deer feed on the Olympic National Forest, Wash. Ladyfern is known to contain *filicic acid* and, for that fact, if it were palatable to domestic livestock, might be injurious.

Bulb cloakfern [*Notholaena sinuata* (Lag.) Kaulf.], a rather small fern, occurs in rock crevices, rocky loams, and in canyons, in weed and brush types, often on limestone, from western Oklahoma and western Texas, through New Mexico and Arizona, to southern California and south, through Mexico, Central America, the West Indies, and South America as far as Chile. As might be expected from its enormous range, it is extremely variable and numerous varieties and other segregates have been proposed.

Kearney and Peebles *(109)* refer to *Notholaena sinuata* as very common in Arizona between 3,000 and 7,000 feet. The fronds, about 4 to 12 inches high, are simply pinnate with coarsely lobed leaflets often of an oblong type, densely covered with scurfy scales *(paleaceous)* below and with star-shaped scales above which tend

to disappear with age; the frond stalks have rusty-woolly tufts at the base and arise from a thickened woody rootstock with bulb-like swellings. This fern has not been observed to be grazed on national forests.

A smaller variety of this plant with much smaller, rounder, and untoothed or few-toothed leaflets *(pinnae)* is called jimmyfern and was formerly identified as *Notholaena sinuata* var. *integerrima* Hook. However, in 1942 Kearney and Peebles *(109)* indicated that this variety is confined to Mexico and that United States material so-called is var. *crenata* Lemmon (syn. *N. cochisensis* Goodding). In a later edition of their work *(110)* they called this plant var. *cochisensis* (Goodd.) Weatherby.

Jimmyfern [*Notholaena sinuata* var. *cochisensis* (Goodd.) Weatherby] is now known to be an important Southwestern stock-poisoning plant. Its toxic character was proved in 1942 by Mathews *(138)* although, strange to say, in 1945 *(139)* his experiments indicated that the typical form of *N. sinuata* is not toxic; this seems to strengthen his argument that the toxic form should be considered a distinct species as Goodding originally proposed.

Jimmyfern is evidently in need of full study, especially in view of its enormous range and great variability. Sperry, et al. *(184)* indicate that control of the plant is difficult; losses usually occur in winter; death may occur suddenly; the disease occurs in sheep, goats, and cattle in that order of severity; and it is important that livestock have ready access to water in areas where jimmyfern is prevalent. The common name arises from the trembling nervousness ("jimmies") which affected animals exhibit.

Licorice-fern [*Polypodium glycyrrhiza* D.C. Eaton, syns. *P. occidentale* (Hook.) Maxon, *P. vulgare* var. *occidentale* Hook.] is a Pacific coastal fern, from Alaska to San Mateo County, Calif., growing on trees, logs, and rocks in moist spruce, fir, hemlock, Douglas-fir, and redwood types. Its thin pinnatifid fronds are 8 inches to 2½ feet long. The rootstocks have a licoricelike flavor and are relished by children; also locally roasted and used as a confection. Apparently it has not forage importance.

Giant hollyfern [*Polystichum munitum* (Kaulf.) Presl, syn. *Aspidium munitum* Kaulf.], a rather coarse, chiefly Pacific coastal fern, is often abundant in wet forests from Alaska to California but occurs inland to British Columbia, northern Idaho, and northwestern Montana. The fern, tufted, once-pinnate fronds, 1 to 5 feet long, arise from a stout woody ascending rootstock, their stalks *(stipes)* copiously brown-glossy-chaffy; the pinnae ("leaflets") are lance shaped, tapered, and margined with incurved, sharp, bristly teeth. Burtt-Davy *(34)* reports that, in northwestern California, this plant "is eaten readily by calves and stock for a day or two after feeding on clover on the ranges." Giant hollyfern is often called **"swordfern"** and **"Christmas-fern"** [names probably better applied, respectively, to the genus ***Nephrolepis*** and to the eastern ***P. acrostichoides* (Michx.) Schott**]. This and other species of the genus are frequently collected as Christmas greens.

Bracken [*Pteridium aquilinum* (L.) Kuhn, syn. *Pteris aquilina* L.] (fig. 1), "the most widely distributed of all ferns" (Eaton) occurs, in various varieties and forms, almost throughout the world. In North America it is "everywhere" (Underwood). This fern is perennial from stout, blackish, cordlike, widely creeping rootstocks. The stalks *(stipes)* are solitary, straw color to brownish, erect, rigid, swollen, and discolored at the base, naked (not chaffy as in many ferns); the fronds, or leaves, more or less triangular in outline, about 1½ to 7 feet long (occasionally even larger) and 1 to 3½ feet wide, divided into 3 main divisions *(ternate)* these 3 branches each again divided into opposite segments *(bipinnate)*, and these segments further divided into opposite oblong, or lance-shaped ultimate divisions *(pinnules)*, the uppermost pinnules undivided, the lower more or less cleft.

Bracken occurs in this country in at least two common varieties, **western bracken *(Pteridium aquilinum* var. *pubescens* Underw.)** and **eastern bracken [var. *latiusculum* (Desv.) Underw.,** syn. *P. latiusculum* (Desv.) Maxon]. Western bracken ranges from Quebec to Alaska and south to California, South Dakota, and northern Michigan. The tips of its rootstocks *(rhizomes)* are dark haired, the coverings *(indusia)* of the narrow spore clusters *(sori)* are hairy *(villous)* or fringed *(ciliate)*, the leaves are more or less silky hairy or woolly, especially beneath, and the pinnules are borne nearly at right angles to the axes of their leaf branches *(pinnae)*. Eastern bracken occurs in Europe, Asia, and eastern North America, south into Mexico, and as far west as Oklahoma and the Rocky Mountains. The tips of its rootstocks are whitish hairy, the fruiting indusia are hairless *(glabrous)* and not fringed, the leaves are hairless or only slightly pubescent, and the pinnules are broader and borne obliquely.

Bracken grows in a variety of sites, in both moist and fairly dry and poor soils, but attains its most luxurious growth in thicket-like stands in rich bottom lands. In the western range country it probably reaches its greatest abundance and size in Douglas-fir areas west of the Cascade Mountains of Washington and Oregon and is also very abundant in parts of Idaho and California; it ranges from near sea level up to about 10,000 feet in Colorado. In the Southwest it usually occurs in mountain parks and along streams where the soil is moist and fertile. It is common along roadsides, field borders, in openings and parks of the ponderosa pine and aspen types, and is a frequent invader of burns and cut-over areas. An aggressive plant, because of its extensive system of rootstocks and voluminous spore production, it often becomes a pestiferous weed and difficult to eradicate in cultivated fields and pastures. When dry in the fall it may become a serious fire hazard. Bracken is often called brake; however, brake is better applied to the large, chiefly tropical Old World genus *Pteris*.

As a rule bracken is regarded as of distinctly minor importance on the range, if not actually unpalatable to livestock; however, under some circumstances it may be rather extensively grazed by all kinds of stock, especially after frost in the fall. Burtt-Davy

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FIGURE 1.—Western bracken (*Pteridium aquilinum* var. *pubescens* Underw.). From left to right: Rootstock and stipe base; frond; two (enlarged) sori, or clusters of spore sacs (*sporangia*), the left one discharging fruiting spores; underside of pinnule tip (enlarged).

(34, p. 63) speaks of the rootstocks being eaten by swine. However, it has a rather long history as a possible stock-poisoning plant. Müller *(143)* states that bracken ["Adlerfarn (kraut)"] straw, or hay ("Häcksel") may cause serious illness in horses, including nervousness, loss of equilibrium, dilated pupils, reddening and later yellowing of the conjunctiva of the eyes, slowing of pulse, and, in at least one observed case, death. Long *(123)* adds: "Continental authorities say that bracken contains the poisonous *Pteritannic acid,* which is identical with the *Filicic acid* of the Male Fern *(Aspidium filix-mas)*." Pott *(162,* 2:274) writes that, in Germany, when bracken is abundant on heathland or in dry woods and eaten by cattle, bloody urine results or, with horses, nervous symptoms ("Gehirnleiden") appear, occasionally with fatal results.

Lawrence *(116)* states that horses may acquire a taste for bracken, and that "fern staggers" due to this plant are the most common poisonous-plant effect in western Oregon; it is slow acting, as symptoms do not appear until after a month or so of feeding on hay in which bracken constitutes about a third or more. This happens especially in dry seasons and when good hay is scarce or unobtainable. The disease has been recognized in western Oregon since pioneer days and horse fatalities are reported almost every year from it, especially in the foothills of the Cascade and Coast Mountains. Glover and Robbins *(82)* list bracken as "the only fern in Colorado that is suspected of being poisonous."

Deerfern, or elkfern [***Struthiopteris spicant*** **(L.) Weis,** syn. *Blechnum spicant* (L.) J. E. Smith], one of numerous ferns locally known as "swordfern" and the only species of its large genus native to this country, occurs in Europe and Asia and, in our Pacific area, in moist coastal forests from Alaska to Santa Cruz, Calif. The numerous tufted pinnate fronds grow in a circle, the taller fertile fronds in the center and from 6 inches to about 5 feet tall. It is reported to be the principal winter deer feed on the Chugach National Forest, southern Alaska, being abundant in sheltered places where only heavy snows cover it lightly. On the Olympic Peninsula of Washington it is said to be good to very good fall, winter, and spring elk and deer forage and also eaten slightly by cattle.

Other fern genera common in the western range country are **spleenwort** ***(Asplenium*** **spp.), lipfern** ***(Cheilanthes*** **spp.), bladderfern** ***(Cystopteris*** **spp.), cloakfern** ***(Notholaena*** **spp.), cliffbrake** ***(Pellaea*** **spp.),** ***Woodsia*** **spp., and chainfern** ***(Woodwardia*** **spp.).** Some of these have value as ground cover and as ornamentals but their forage value is chiefly nil.

LILY FAMILY (LILIACEAE)

This is one of the largest and best known families of flowering plants; a conservative estimate gives about 39 genera and 311 species native to the 11 Far Western States, the family being especially well developed in California. The onion genus *(Allium),*

with about 83 species in the western range area, is the largest group. Great diversity exists among botanists as to where the limits of this family should be drawn; some separate one or more of the seven subfamilies mentioned in this discussion into distinct families; others remove some of the genera mentioned into different families. It is believed, however, that the treatment presented here approximates majority botanical opinion.

With the exception of the dracaena subfamily (Dracaenoideae), many of which are arborescent or shrubby, the genus *Smilax* (mostly more or less woody vines), and certain species of *Asparagus,* members of the lily family are usually perennial herbs, arising from a bulb, corm, rootstock, or crown with fibrous roots. The leaves are typically rather narrow but may be broad (as in false-hellebore, *Veratrum),* basal or alternating in two ranks on the stem, or sometimes whorled (as in some lilies and fritillaries).

The flowers are often showy and more or less colored, and are usually 6 parted, the 3 lower segments ("sepals") and the upper 3 ("petals") mostly similar in appearance (except in *Calochortus* and *Trillium);* ordinarily there are 6 stamens (1 opposite each perianth segment) but 3 of these are sometimes sterile and reduced to *staminodia,* and in the beadruby genus *(Maianthemum)* there are 4 perianth parts and 4 stamens; pistils are 3 or sometimes 1 and the ovary superior; the fruit is usually a 3-lobed podlike capsule (which may sometimes be fleshy and more or less edible in *Yucca),* splitting when ripe typically down the middle of the back *(dorsal suture)* of each carpel *(loculicidal dehiscence)* or dividing at the partitions *(septicidal dehiscence),* or else the fruit may be a berry (as in asparagus and Solomonseal).

The lily family is usually separated from the amaryllis (Amaryllidaceae) and iris (Iridaceae) families, both of which have inferior ovaries. The amaryllis family has the flowers mostly in umbels (which is one of the reasons some botanists place the onion genus and the Brodiaea group in that family), the tube of the flower more or less fused with the ovary, 6 stamens and inturned *(introrse)* anthers. The iris family has flowers in a spathe, 2-ranked clasping *(equitant)* leaves, 3 stamens and outward-turned *(extrorse)* anthers.

With perhaps a few minor exceptions the lily family, aside from the onion genus *(Allium)* and the poisonous plants in the bunchflower subfamily (Melanthioideae)—deathcamas, false-hellebore, tofieldia, etc., is not of major importance from the range livestock-feed standpoint. The family is notable for the great number of species with large and showy, often bright-colored and fragrant flowers and is one of the most important groups in ornamental horticulture. Several species of *Allium,* the garden onion, chives, garlic, leek and shallot, are cultivated as vegetables, in addition to **garden asparagus** ***(Asparagus officinalis* L.).**

The lily family also contains a number of official drug plants, including **Mediterranean aloes** ***(Aloe barbadensis* Mill.,** syn. *"A. vera"* of authors, *not* L.), **Cape aloes** ***(A. ferox* Mill.), Perry aloes** ***(A. perryi* Baker), autumn-crocus** ***(Colchicum autumnale* L.)** from

which colchicine is derived, **lily-of-the-valley** ***(Convallaria majalis*** **L.), saffron crocus** ***(Crocus sativus*** **L.), drug sabadilla** ***(Schoenocaulon officinale*** **A. Gray), Mexican sarsaparilla** ***(Smilax aristolochiaefolia*** **Mill.,** syn. *S. medica* Schlecht. & Cham.), **Jamaica sarsaparilla** ***(S. regelii*** **Killip & Morton), India drugsquill** ***(Urginea indica*** **Kunth), shore drugsquill [*** ***Urginea maritima*** **(L.) Baker,** syns. *Scilla maritima* L., *U. scilla* Steinheil], and **false-hellebore** ***(Veratrum*** **spp.).** Notes on range species of yucca are provided elsewhere *(54, 204)*.

Authorities differ as to the organizational breakdown of this large family into subfamilies and tribes. For convenience the Dalla Torre and Harms *(48)* sequence is here employed, because it is made familiar by use in most of our botanical manuals and larger herbaria.

ONION SUBFAMILY (ALLIOIDEAE)

Onion Tribe (Allieae)

Onion *(Allium)*

This, the largest genus of the lily family with about 500 species, is widely distributed in the Northern Hemisphere; it is represented in the western range area by about 83 species and is especially well represented in California, Oregon, and the Intermountain region. Onions reproduce freely both from seed and underground parts and often grow in dense patches, especially in moist meadows but they occupy sites varying from rather dry plains and foothills to thickets and woodlands. They are perennial, mostly bulbous, stemless (save for the flower stalk) herbs with the characteristic onionlike *(alliaceous)* smell and taste. It has been shown that this is due to an essential oil "specific for each species" *(160)*.

The deep rose to white flowers have a 6-parted perianth (or, as some botanists prefer, 3 sepals and 3 petals), free or slightly united at the base, borne in a simple bracted umbel at the apex of an erect, leafless scape. The leaves are mostly linear, flat or round in cross section *(terete)*. In collecting onions care should be taken to get good representation of the parts underground since these have great diagnostic value, especially in regard to the presence or absence of rootstocks, and the character of the bulbcoats, whether fibrous, membranous, netlike *(reticulated)*, etc.

Most onions are eaten greedily by cattle and sheep but only occasionally by horses. Unless grazed judiciously they are objectionable for dairy cows because the volatile oils flavor the milk. The different species vary considerably in size and amount of herbage. Some small species spring up quickly after the snow melts but wither and blow away with the coming of dry summer weather. A few species, especially the introduced ones, remain green during the season. Wild onions furnish green succulent herbage early in the spring, when their palatability is especially high. Some stockmen make the mistake of turning their livestock onto the

range in order to utilize onions before the main crop of forage plants has developed sufficiently to justify grazing. Such a practice is injurous to the more permanent vegetation on which proper seasonal use of the range should be based. Elk in Yellowstone Park and elsewhere feed extensively on onions, especially in spring. Bears dig up and eat the bulbs; Indians also utilized these bulbs as a source of food.

A number of onion species are cultivated as vegetables: **garden onion** ***(Allium cepa* L.)**, **shallot** ***(A. ascalonicum* L.)**, **chives** ***(A. schoenoprasum* L.)** a variety **[*sibiricum* (L.) Hartm.]** of which is native on western ranges, **garlic** ***(A. sativum* L.)**, and **leek** ***(A. porrum* L.)**. Garlic is also an official drug plant *(216)* and the United States Dispensatory *(147)* indicates that the native **Canada garlic** ***(A. canadense* L.)**, which gets as far west as South Dakota, Colorado, and Texas and is a familiar weed in lawns and other cultivated grounds, is an acceptable substitute for it. Pipal *(157)* reports that the death in June 1917 of five cows and a heifer near Lafayette, Ind., appeared to be the result of eating Canada garlic but it seems difficult to accept this plant as definitely toxic. Another well-known pestiferous weed is **field** (or meadow) **garlic** ***(A. vineale* L.)** with tubular leaves. A number of species of *Allium* are cultivated as ornamentals, e.g., the yellow-flowered **lily leek**, or moly ***(A. moly* L.)**, the blue-flowered **blueglobe onion** ***(A. caeruleum* Pall.)**, and the white-flowered **Naples onion** ***(A. neapolitanum* Cyr.)**.

Tapertip onion ***(Allium acuminatum* Hook.)**, occurring on sagebrush plains, rich meadows, rocky foothills, and mountain slopes, from British Columbia to Montana, Colorado, Arizona, and California, has dark-colored outer bulbcoats with 4- to 6-angled and raised reticulations, or network. The flattened leaves are shorter than the 4- to 12-inch-high flowerstalk. The flowers are dark rose to reddish purple, the segments tapertipped and longer than the stamens, the three upper and inner ones ("petals") minutely toothed on the margins. The plant is highly palatable to sheep and cattle, but it usually grows scatteringly and its foliage is rather scant.

Shortstyle onion ***(Allium brevistylum* S. Wats.)** ranges in foothills or along mountain streams up to subalpine elevations (in Colorado between 6,500 and 9,000 feet), from Montana to Colorado and Utah. The bulbs are elongated and oblique, covered with a thin papery membrane and surmount a woody rootstock. The flowers are rose colored or purplish pink, the stalk *(scape)* 6 to 24 inches high. While not of great abundance it is fairly common and highly palatable to cattle and sheep, at least in the earlier stages of growth.

Rather closely related to shortstyle onion is **Pacific onion** ***(Allium validum* S. Wats.)** (fig. 2), known also as alpine meadow, large, swamp, and tall onion, one of the largest and coarsest of the range species of this genus, which occurs from Washington to Idaho, Nevada, and California, between about 5,000 and 11,000 feet, typically in subalpine or alpine meadows or swamps. Its

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FIGURE 2.—Pacific onion (*Allium validum* S. Wats.).

white-coated, not netted, narrow bulbs are produced on a long rootstock; the stout 2-edged flattened scape, or flower stalk, is 1 to 3 feet high, the leaves long flat and linear, and the flowers rose color to almost white. It is good sheep and cattle forage where it occurs but is usually limited in abundance.

One of the most common and widely distributed species of American onions is **nodding onion** ***(Allium cernuum*** **Roth,** syns. *A. neomexicanum* Rydb., *A. recurvatum* Rydb.) (fig. 3), which ranges from British Columbia south to Lane County, Oreg., New Mexico, Missouri, Kentucky, and the mountains of northern Alabama and Georgia, and north to New York. In the range area it is found in meadows, sagebrush plains, foothills and rocky slopes but is most frequent in moist to dry sandy loams up to about 7,000 feet elevation, mainly in the ponderosa pine belt. Rarely it grows in almost pure stands but is usually associated with such plants as yarrow, dandelion, deathcamas, and bluegrass and fescue species, or grows among willows or on the border of timber or aspen-fir stands.

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FIGURE 3.—Nodding onion (*Allium cernuum* Roth).

Nodding onion grows from a long-necked, narrow, membranous-coated bulb, the bulbs usually clustered on a short rootstock. The usually pink (occasionally white or nearly so) nodding inflorescence, with protruding stamens, is very characteristic, overtopping the flattened linear, ridged leaves, on a stalk 4 to 24 inches high. Flowers appear from May to the latter part of July, the plants maturing and drying up during July and the first half of August. Nodding onion is highly palatable to both cattle and sheep during its green stage, and only its relatively small size, evanescence and usual lack of abundance prevent it from being classed among the most important, early-season forage plants.

Idaho onion ***(Allium fibrillum*** **M. E. Jones,** syn. *A. collinum* Dougl., *not* Gussone) (fig. 4) is a small onion, perennial from a

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FIGURE 4.—Idaho onion (*Allium fibrillum* M. E. Jones, syn. *A. collinum* Dougl., *not* Gussome).

small, almost spherical not at all rhizomatous bulb ¼ to ⅝ inches thick; the outer bulbcoats are net veined *(reticulated),* without fibers until old, the vein nets *(reticulations)* irregular, narrow, contorted with wavy or curving sides, often reddish, in age becoming fiber-fringed *(fimbrillate*—whence the specific name *fibrillum.)* The 2 or 3 leaves are rather narrowly linear, 3 to 6 inches long. The white flowers are in a small, terminal, flat-topped umbel, subtended by 2 ovate bracts less than ½ inch long, the 6 petallike segments abruptly sharp tipped, ¼ inch or a little more long, the 3 outer segments ovate, the 3 inner ones lance shaped and untoothed; the stamens are very short, only about half as long as the

floral segments. The fruiting capsules are slightly ridged but hardly crested.

Idaho onion, often locally abundant, occurs on scablands and high ridges from extreme western Montana, through Idaho to eastern Washington and eastern Oregon. Sampson *(176)*, as a result of his studies in the upland ranges of the Blue Mountains of northeastern Oregon, reports that, of the local wild onions, this "is the most important * * * (it) is the earliest of the species, doubtless from the fact that it is almost entirely confined to scablands * * * It is valuable only as an early range plant, and by August 1, like most other onions in similar situations, completes its growing period, dries up, and disappears."

Geyer onion ***(Allium geyeri* S. Wats.)** ranges from British Columbia to eastern Oregon, Arizona, New Mexico, Colorado, Wyoming, and the Black Hills of western South Dakota. It is named for its discoverer, the German botanist and explorer Charles A. Geyer *(78)*, who traveled and collected extensively in the West between 1835 and 1845. The (usually 3) rather slender leaves, usually shorter than the 6- to 24-inch-high, slightly 2-edged flower stalk *(scape)*, are produced from a fibrous-coated, ovoid, or elongated bulb. The flowers are pink or pinkish, the ovary minutely crested with six small knoblike excrescences.

This onion is usually found in moist to wet meadows or along rocky streambanks in the ponderosa pine type. Supervisor C. A. Ballinger of the old Sioux (now Custer) National Forest (w. S. Dak.—e. Mont.) reported that this "is found in greatest abundance on gumbo or clay soils; is one of the first plants to make its appearance in the spring, and is eaten by cattle and sheep. Where there is little else growing, cattle will eat it until their flesh is so permeated with the odor of onions that it is unfit to eat. Butter and milk from them is likewise tainted."

Some of the other common native western range onions that locally provide considerable early feed for sheep and cattle are as follows: In the Pacific area, **twinleaf onion** ***(Allium anceps* Kell.)**; in California or extending into southern Oregon, **dusky onion** ***(A. campanulatum* S. Wats.)**, **sickleleaf onion** ***(A. falcifolium* Hook. & Arn.)** and **serrate onion**—referring to the sawtoothlike markings of the bulbcoats—***(A. serratum* S. Wats.)**; in the Rocky Mountains, **Brandegee onion** ***(A. brandegei* S. Wats.)** and **textile onion** ***(A. textile* Nels. & Macbride,** *not* J. & C. Presl); in the Intermountain region, **twincrest onion** ***(A. bisceptrum* S. Wats.,** syn. *A. palmeri* S. Wats.); in the Inland Empire area, extending south into northern Utah, **Tolmie onion** ***(A. tolmiei* Baker)**; in the Southwest, **Kunth onion** ***(A. kunthii* Don,** syn. *A. scaposum* Benth.). Also, ranging in a vast area in northern Europe and Asia and, in North America, from Newfoundland, Labrador, and Quebec to Alaska and south to Oregon, Colorado, the Great Lakes region, New York, and Maine, is a native variety of chives, **Siberian chives** ***(A. schoenoprasum* var. *sibiricum* (L.) Hartm.,** syn. *A. sibiricum* L.), with tubular leaves and clustered, whitish-coated bulbs.

The following genera and species, rather closely related to onions, are perhaps worthy of mention as constituents of the range flora, although their forage value is definitely minor not so much because of unpalatability as on account of limited distribution and abundance and the relatively small amount of herbage produced.

Purple funnel-lily ***(Androstephium breviflorum* S. Wats.)**, ranging from southwestern Colorado to southern Utah and southern California, has leaves longer than the naked flower stalk *(scape)* and light violet-purple flowers. Another species, **blue funnel-lily [*A. caeruleum* (Scheele) Greene,** syn. *A. violaceum* Torr.], in ornamental cultivation, occurs from Kansas to Texas. These two United States species appear to comprise the genus *Androstephium,* a genus with bulblike corms, grasslike basal leaves, and spring-produced flowers in an umbel (as in onions and members of the parsnip family). The 6 flower segments *(perianth,* or *corolla)* are united to about the middle or above into a funnellike tube, the lobes flaring at the top; the 6 stamen stalks *(filaments)* are more or less united into a tubular *corona* [to which *Androstephium,* Latinized from the Greek prefix *άνδρο* (man) + *στέφος* (crown, or garland) refers], with 2-toothed lobes between each of the 6-inturned *(introrse)* anthers.

Bloomeria ***(Bloomeria* spp.)** is a summer-flowering California genus of two species, **Cleveland bloomeria** ***(B. clevelandii* S. Wats.)** of the San Diego area, and **darkstripe bloomeria [*B. crocea* (Torr.) Coville],** a coastal species (also in cultivation) getting into Lower California. They have bulblike corms, "wheel-shaped" yellow 6-parted flowers on jointed stalks *(pedicels),* the petallike segments 2 to 3 nerved, and stamen stalks *(filaments)* with cup-shaped winged appendages at base. *Bloomeria* commemorates Mr. H. G. Bloomer, an early botanical curator of the California Academy of Sciences. The species are often called "goldenstars," a name too conflicting with **goldenstar** ***(Chrysogonum* spp.)** and **goldstar** ***(Crocidium* spp.)**.

Mexican-star ***(Milla biflora* Cav.)**, the only known representative of its genus, occurs in the oak belt and ponderosa pine type of southern New Mexico and Arizona and south into southern Mexico, where it was discovered and described by the Spanish botanist Antonio Jose Cavanilles (1745–1804). Cavanilles named it after the superintendent of the Royal Garden of Madrid, Don Julian Milla. It has grasslike basal leaves from a bulb with fascicled tuberous roots below it; salverform, waxy-white (with green midvein) fragrant flowers about 2 inches across, solitary or in 2- or 3-flowered umbels; stigma large and prominent; stamens not united, and the flower stalk *(pedicel* or *scape,* as the case may be) somewhat swollen at the top. It is cultivated as an ornamental.

Muilla ***(Muilla* spp.)**, which is just *Allium* spelled backwards, is an onionlike California genus of 3 or 4 species. They have father few, narrow, rounded leaves about the same length as the flower stalk, arising from a bulblike corm. The individual flowers, borne on long unjointed stalks *(pedicels)* in an umbel, are 6 parted, the segments slightly united at base, without a tube, mostly 2

nerved, the 6 stamens brightly colored, with their stalks *(filaments)* thickened, dilated or winged at the base, and with anthers attached by their middles *(versatile)*. Probably the best known species is **sea muilla [*M. maritima* (Torr.) S. Wats.]**, a coastal and inland valley species, chiefly on alkaline or serpentine soils, with no glands on the perianth segments and bright purple anthers.

Texas falsegarlic *(Nothoscordum texanum* M. E. Jones), with slightly fragrant, yellowish-white flowers tinged with purple, is distributed from western Texas to southern Arizona and south into northern Mexico, inhabiting dry gravelly plains and lower slopes. A related species, **yellow falsegarlic [*N. bivalve* (L.) Britt.]** occurs in the Southeast, getting as far west as Nebraska and Texas. *Nothoscordum,* whose name derives from Greek νόθος (bastard) + σκόδρον (garlic), in an onionlike genus of bulbous herbs and differing chiefly in the total lack of alliaceous odor and with the presence of more than two ovules in each ovary cell. Its generic limits are in controversy. At least two of the species are in ornamental cultivation.

Brodiaea *(Brodiaea)*

Brodiaea, under a conservative nomenclature, is a west-American genus of about 31 species. Nomenclaturally it has been a bone of contention. First, under the International Code of Botanical Nomenclature, *Brodiaea* (1810) is conserved as against the older *Hookera (1808)*. Both genera are based on the same type species [*B. coronaria* (Salisb.) Jeps., syns. *B. grandiflora* J. E. Smith, *Hookera coronaria* Salisb.]. Sir James Edward Smith, M. D. (1759–1828) read his paper on *Brodiaea* before the Linnean Society of London on April 19, 1808, but it was not actually published until 2 years later, naming it in honor of his wealthy patron and fellow member of the Linnean Society, James Brodie of Scotland.

Another British botanist, Richard Anthony Salisbury (1761–1829), had previously published *Hookera,* named for William Hooker of the famous line of British botanists of that surname. Smith knew that Salisbury had preceded him in naming this genus and a bitter controversy arose between them, as Britten has pointed out in his paper *Hookera* v. *Brodiaea (32)*. In addition to the confusion caused by these almost simultaneously published two names for the same genus is the fact that this original generic concept has been broken down since by many others into a dozen or more other genera, among which are *Calliprora, Dichelostemma, Dipterostemon, Hesperoscordum, Macroscapa* (syn. *Stropholirion),* and *Triteleia.* Those interested in the taxonomy and nomenclature of this group will find, among others, the papers by Burbanck *(33)* and Hoover *(98, 99)*, with their bibliographies, to be of interest.

Brodiaea (including the segregates mentioned) occurs also in South America. California, with about 22 species, is the center of distribution. One species each is confined to Arizona and Washington; also to Montana-Idaho-Utah, New Mexico-southern Utah,

and Washington-Oregon. The remainder of our native species inhabit the Inland Empire, Intermountain, and Pacific areas.

The herbage of brodiaeas is palatable to all classes of livestock, at least until the flower heads mature. When the ground is wet enough, grazing animals will often pull up the bulbs and eat them. As a rule the plants are so scattered, rather evanescent, and the leafage so limited in quantity that they are not a material factor in range grazing capacity; there are, however, limited localities where brodiaeas are fairly valuable from the forage viewpoint.

Bluedicks brodiaea [*Brodiaea capitata* Benth., syns. *Dichelostemma capitatum* (Benth.) Wood, *Dipterostemon capitatus* (Benth.) Rydb., *Hookera capitata* (Benth.) Kuntze] has an unusually wide range for this genus—from southern Oregon to Utah, Arizona, and southern California. Its showy flower stalks are 8 to 20 inches high with the umbel of bluish, violet or purple flowers congested and somewhat headlike *(capitate)*. It is locally fairly common on rocky hillsides, flowering in April-June or, in the south, as early as February-March.

Harvest brodiaea [*Brodiaea coronaria* (Salisb.) Jeps., syns. *B. grandiflora* J. E. Smith, *Hookera coronaria* Salisb.], the botanical type of both *Brodiaea* and *Hookera*, a violet-purple-flowered species ranging on plains, foothills and mountains between 200 and 8,000 feet, from British Columbia to California (west of the Sierra Nevada), is reported to invade burns on certain forest areas.

Douglas brodiaea [*Brodiaea douglasii* S. Wats., syns. *Hookera douglasii* (S. Wats.) Piper, *Triteleia grandiflora* (J. E. Smith) Lindl., *B. grandiflora* (Lindl.) Macbride, *not B. grandiflora* J. E. Smith], with dark blue flowers, is found in sagebrush, bunchgrass, and ponderosa pine types, between elevations of about 2,100 and 8,300 feet from British Columbia to western Montana, western Wyoming, Utah, and Washington and Oregon (east of the Cascades); it has not been observed in either Colorado or California. This species has been reported as a "good" forage plant on one of the ranges of the Colville National Forest in northeastern Washington.

The bulbs of brodiaeas formed, when abundant, a rather important source of food to the Indians and early settlers, and some of them, in fact, have a very agreeable flavor. Chesnut *(37)* has noted five species as being valued by the Indians of Mendocino County, Calif.; of *Brodiaea capitata* he says "the bulbs are eaten raw, but are sweeter when cooked in ashes." Of *B. coronaria*, he adds: "The brown-coated corm * * * is greatly relished by sheep as well as by the Indians. It is sweet after roasting for a day. The Yuki name is *ant-pot*."

Chesnut has somewhat similar notes also for two California species, **grassnut brodiaea [*Brodiaea laxa* (Benth.) S. Wats.,** syns. *Hookera laxa* (Benth.) O. Kuntze, *Triteleia laxa* Benth.] and ***longstalk brodiaea* [*B. peduncularis* (Lindl.) S. Wats.,** syns. *Hookera peduncularis* (Lindl.) O. Kuntze, *Triteleia peduncularis* Lindl.]; also for **hyacinth brodiaea [*B. hyacinthina* (Lindl.) Baker,** syns.

Hesperoscordum hyacinthinum Lindl., *H. lacteum* Lindl., *Hookera hyacinthina* (Lindl.) O. Kuntze, *Tritèleia hyacinthina* (Lindl.) Greene], the botanical type of the genus *Hesperoscordum,* with flowers white with greenish or purplish midveins, and which ranges from British Columbia and Vancouver Island to Washington, Idaho, Nevada, and California. More than 20 species of brodiaea are in the horticultural trade as ornamentals *(8, 10).*

Very close botanically to the genus *Brodiaea* and perhaps to be merged with it is the spectacular **floral-firecracker** ***(Brevoortia ida-maia* Wood)**, occurring in coastal and near-coastal forests of northwestern California and southwestern Oregon. It has umbels of showy scarlet tubular drooping flowers with an inner corona of three dilated sterile stamens *(staminodia).* The genus, named after J. Carson Brevoort, an early New York naturalist and regent of the State University, is a prized ornamental.

ASPARAGUS SUBFAMILY (ASPARAGOIDEAE)

The type of this subfamily is the large Old World genus *Asparagus,* to which the **garden asparagus** ***(Asparagus officinalis* L.)**, the florists' "smilax" (a gross misnomer), **Smilax asparagus [*A. asparagoides* (L.) Wight]** and numerous ornamentals belong. The subfamily is represented in the western range country by the following tribe.

Solomonseal Tribe (Polygonatae)

This tribe is represented in the Far West by 7 genera of perennial herbs: **beadlily** ***(Clintonia)*,** with 2 species; **fairybells** ***(Disporum)*,** with 6 species; **kruhsea** ***(Kruhsea)*,** a monotypic arctic genus that reaches northern Washington; **beadruby** ***(Maianthemum*,** syn. *Unifolium)*—*Maianthemum* (1780) is conserved, under the International Code, against *Unifolium* (1757)—with 2 species; **Solomonseal** ***(Polygonatum)*,** with one endemic species in New Mexico and another eastern species which barely reaches the range area from North Dakota to Oklahoma and Texas; **Solomonplume,** or false-Solomonseal ***(Smilacina,*** syn. *Vagnera)*, with 5 species; and **twistedstalk** ***(Streptopus)*,** with 3 species.

In general these plants have alternate (basal in *Clintonia* or sometimes solitary in *Maianthemum),* rather broad (often ovate) leaves, and the fruit is a berry. All have a flower of six distinct petallike parts, except *Maianthemum* which has four. *Clintonia, Kruhsea, Maianthemum,* and *Smilacina* have the petallike floral segments more or less spreading; in *Disporum, Polygonatum,* and *Streptopus* the flowers of pendulous, and more or less bell-like. In the two genera last named the flowers are axilliary, in the others terminal and often paired or few except in *Smilacina* where they are massed in panicles or racemes. Many of these plants are ornamental; their palatability to domestic livestock is limited, varying from nil to poor or at most fair. Deer are fond of the berries of Solomonplume *(Smilacina* spp.).

A common representative of this group is **fat Solomonplume** [***Smilacina amplexicaulis*** **Nutt.**, syn. *Vagnera amplexicaulis* (Nutt.) Greene] (fig. 5), which ranges in moist wooded hillsides up to the ponderosa pine, fir, and aspen types in the mountains, from British Columbia and Alberta to Montana, New Mexico, and California. It reaches a height of from 1 to 3½ feet, has a stout elongated rootstock, alternate ovate clasping leaves 2 to 6 inches long, and (often dense) terminal panicle of white flowers, and red berries with purplish dots. *Smilacina* (1807) is conserved, under the International Code, against *Vagnera* (1763).

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FIGURE 5.—Fat Solomonplume (*Smilacina amplexicaulis* Nutt.). *Upper left,* flower; *lower right,* fruiting tip; *bottom,* lower stem and rhizome.

ASPHODEL SUBFAMILY (ASPHODELOIDEAE)

This subfamily is represented on the western range by three herbaceous tribes.

Asphodel Tribe (Asphodeleae)

This tribe includes 5 genera and 9 species of range plants of no forage value. **Torrey anthericum** ***(Anthericum torreyi*** **Baker)** chiefly occurs in ponderosa pine forests from western Texas to Arizona and south into Mexico. It belongs to a large, mostly Old World genus, which includes the cultivated ornamental **St. Bernard-lily** ***(A. liliago*** **L.)**.

Amole soapplant [*Chlorogalum pomeridianum* (DC.) Kunth, syn. *Laothoë pomeridiana* (DC.) Raf.] is a coarse herb from a deep-seated large bulb covered with blackish horsehairlike fibers; is has a cluster of wavy basal leaves up to 18 inches long and 1 inch wide, a flower stalk up to 4 feet high with 1 or 2 greatly reduced leaves, and a panicle of white, purple-striped flowers opening in the late afternoon in midsummer when the leaves are drying. It grows in valleys and on rocky hillsides from northern California to southwestern Oregon. The bulbs contain saponin and have been used as a soap substitute. It was an important plant to the native Indians—see, for example, Chesnut *(38):* they roasted and ate the leaves, used the bulbs for soap and glue, the bulbcoat hairs for stuffing mattresses, etc. *Chlorogalum* is a genus of 5 species, almost confined to California, 1 species getting north into Oregon and another into Lower California.

Eremocrinum ***(Eremocrinum albomarginatum*** **M. E. Jones)** is found on dry "desert" areas and in the sagebrush type of southern Utah and northern Arizona. The only species known of its *(monotypic)* genus, it is an evanescent plant, 6 to 12 inches high, from a narrow somewhat bulbous base bearing below a cluster of fibrous roots. The six perianth segments ("petals"), not united or only slightly so, are white with green veins; the flowers are borne in a narrow erect panicle. The plant is rather attractive in bloom but of no known economic value. The name *Eremocrinum* is Greek for "desert lily" and Jones *(108)* wished to call it by that name; however, "desertlily" is a well-established name for the genus *Hesperocallis.*

Odontostomum ***(Odontostomum hartwegii Torr.)*** is another monotypic Californian species. It is a rather rare plant of dry hillsides, from a deep-seated round corm about 1 inch in diameter. The white or yellowish, somewhat tubular flowers are in a terminal panicle. The name *Odontostomum,* meaning "toothed mouth," refers to the 6 somewhat toothlike sterile stamens *(staminodia)* in the throat of the flowers, alternating with the 6 fertile stamens.

Rushlily ***(Schoenolirion)*** is a genus of 5 species, 3 eastern, and 2 in California and southern Oregon. They are somewhat rushlike plants growing in moist meadows, near streams and the like, with grasslike leaves and mostly narrow racemes or panicles of rather small, 6-parted white or greenish flowers. *Schoenolirion* Durand

(1855)—the name is Greek for "rush lily"—is conserved under the International Code against *Amblostima* Raf. (1836) and *Oxytria* Raf. (1836).

Daylily Tribe (Hemerocallideae)

Two range genera belong to this tribe, the type of which is the cultivated daylily genus *(Hemerocallis)*.

Desertlily ***(Hesperocallis undulata* A. Gray)** grows in the creosotebush and other desert types, mostly below 2,000-foot elevations, from southern Arizona to the Imperial Valley, southern California, probably extending southward into Sonora. It is a rather showy, bulbous perennial, with mostly basal leaves, the bracted, funnel-shaped, whitish and green-striped, soon-withering flowers up to nearly 2 inches long, borne on jointed pedicels in a terminal raceme up to about a foot long. It is occasionally cultivated as an ornamental. It is of little or no forage value. The bulbs are eaten by local Indians.

Common starlily, also known as "mountainlily," "sagelily," and "sandlily" ***(Leucocrinum montanum* Nutt.)** is a low stemless plant from a short, deep-seated rootstock, with linear leaves and sheathed at the base with membranous or skinlike bracts. The 3 to 8 white, fragrant, "starlike" flowers have a slender elongated basal tube and are borne in a sessile umbel. It occurs, mostly in sandy soils and often in sagebrush areas, from the Black Hills of western South Dakota to Oregon, California, Utah, Colorado, and New Mexico. It appears not to have been found in Washington, Idaho, and Arizona. The roots are eaten by various Indians and are reputed to have an agreeable flavor. Blankenship *(27)* reports that the Crow Indians call the plant "ecopa." Ordinarily the forage value is negligible, but occasionally the plant has been observed to be limitedly cropped by sheep and cattle.

Herb-Paris Tribe (Parideae)

This tribe is named for the Old World herb-Paris *(Paris)*. It includes two range genera.

The **skunklily** ***(Scoliopus)*** genus sometimes called "fetid adderstongue," consists of 2 species: 1 Californian and 1 Oregonian. They inhabit moist coastal redwood and fir forests and are small stemless plants with broad spotted leaves somewhat reminiscent of those of fawnlily, or "adderstongue" *(Erythronium)*. The small, homely, ill-smelling flowers, with parts distinctly in 3's, are borne on twisting stalks *(pedicels)*—referred to in the scientific name. Of no forage value.

Trillium ***(Trillium)***, often called "wakerobin," is an ornamental North American and Old World genus, with about 12 species in the Eastern States and about seven species in the western range States. The genus does not occur in New Mexico and Arizona. The most widely distributed of the range species is **Pacific trillium** ***(T. ovatum* Pursh)**, which ranges in moist spots in spruce, aspen, and ponderosa pine types from British Columbia to Montana,

Colorado, Utah, and California. Like all trilliums this species has a rootstock, an unbranched stem bearing a whorl of 3 leaves at the summit and one showy 3-petaled, 3-sepaled flower. These plants are seldom touched by domestic livestock and presumably are more or less poisonous. All parts of the plant, especially the rootstocks and berries, have emetic properties. The rootstock of the eastern **purple trillium** ***(T. erectum*** **L.)** is an official drug. A number of the species are in ornamental cultivation.

DRACAENA SUBFAMILY (DRACAENOIDEAE)

This subfamily is represented in the western range country by two tribes and three genera. The type of the subfamily is the **dracaena** ***(Dracaena)*** genus, in turn typified by the **dragontree,** or dragon dracaena ***(Dracaena draco*** **L.)** of the Canary Islands, of which the most famous representative was the giant dragontree of Tenerife Island. This giant tree was destroyed by a hurricane in 1868 and was reputed at that time to be the oldest living thing on earth, its age having been estimated to date from the Great Pyramid of Cheops in Egypt, over 4,700 years before. Dragonsblood, a gum exuded by the dragontree, was formerly much used in the arts, as a red pigment in photoengraving, for varnish, etc.

Nolina Tribe (Nolineae)

The western range representatives of this tribe belong to two genera, both chiefly Mexican, and confined, so far as the United States is concerned, to the area extending from western Texas to southern California. **Sotol** ***(Dasylirion)*** is represented in the United States by about 5 species, and **nolina** ***(Nolina),*** often called "beargrass," which includes **sacahuista** ***(N. microcarpa*** **S. Wats.),** by about 5 species. Range notes for these two more or less woody plant genera are given in Important Western Browse Plants *(54, p. 15)*. Bell and Castetter *(16)* mention the uses of these plants by Southwestern Indians.

Yucca Tribe (Yucceae)

So far as the range area is concerned this largely woody tribe consists of the genus **yucca** ***(Yucca),*** range notes for which are given in Important Western Browse Plants *(54)* and the Range Plant Handbook *(204)*.

LILY SUBFAMILY (LILIOIDEAE)

Squill Tribe (Scilleae)

This is the tribe to which the cultivated ornamental squills, also called "bluebell," "scilla," and "star-hyacinth" *(Scilla)* and the closely related **sea-onion** ***(Urginea)*** genus belong. **Shore drug-squill** [***Urginea maritima*** **(L.) Baker,** syn. *Scilla maritima* L.], of the Old World, is an official drug plant but its chief economic significance is the use of the bulbs as a standard rat poison, under

the trade name "red squill." The bulbs of **India drugsquill [*U. indica* (Roxb.) Kunth,** syn. *Scilla indica* Roxb.] are a substitute.

Camas *(Camassia,* syn. *Quamasia)*

This genus consists of about six species, with one exception confined to the Far West. All are in ornamental cultivation. Northwestern Indians called them "quamash," from which English camas is derived. They have various other vernacular names, including swamp-sego, wild-hyacinth, or blue camas—the last to distinguish them from the poisonous, greenish or whitish flowered deathcamas *(Zigadenus)*. Camases are perennial herbs from coated bulbs, with long, narrow basal leaves and naked or bracted stalks *(scapes)* up to about 2 feet high. The blue, purplish or occasionally white flowers, in terminal racemes, appear chiefly from May to July, each flower composed of 6 separate segments in 2 series, with 6 included versatile anthers.

A very characteristic member of this genus is **common camas [*Camassia quamash* (Pursh) S. Wats.,** syns. *C. esculenta* Lindl. *not* (Ker) Rob., *Quamasia quamash* (Pursh) Coville], ranging in high mountain meadows where often abundant, from British Columbia to Montana, Utah, and California. The dense stands of waving flowers often give the distant appearance of a body of water. The palatability of this and most other camases varies from fair to fairly good, occasionally good for sheep. On the high summer ranges camases are little grazed because they bloom, dry up, and disappear before the sheep are moved to those ranges. Camases ordinarily grow on sites too wet for sheep. If given a choice, horses and cattle do not ordinarily graze camas, but they frequently eat these plants along with other meadow forage and the plants are not objectionable when cured in mixed native hay *(204)*.

The bulbs of camases, with one exception, are edible and were an important source of food among western Indians, as Chesnut, Coville, Havard, Leiberg, and others *(38, 47, 91, 118)* have pointed out. Geyer *(78)*, in speaking of "Oregon Territory" Indians in 1843–4, says: "The digging of the Gamass bulb is a feast for old and young * * * the young women vie with each other in collecting the greatest possible quantity and best quality of Gamass, because their fame for future good wives will depend much on the activity and industry they show here; the young men will not overlook these merits, and many a marriage is closed after the Gamass are brought home." However, the bulb of a tall, pale-blue-flowered, relatively broad-leaved Blue Mountains, Oregon, species **Cusick camas *(Camassia cusickii* S. Wats.)**, has a nauseating taste. This species is named for its discoverer, W. C. Cusick, an early amateur botanist and collector of Union, Oreg.

Tulip Tribe (Tulipeae)

To this group belong the familiar Old World tulip *(Tulipa)* genus and five range genera.

Mariposa *(Calochortus)*

This attractive group of coated-bulbous herbs is confined to southern British Columbia, the Western United States and Mexico. California (especially) and Oregon are the center of distribution. Ownbey *(149)* lists 57 species, of which about 45 occur in the Western States. They occur from the dry open prairies and foothills to the higher moist and shady alpine meadows and woods. They are rather fragile perennials with a few basal and somewhat grasslike leaves, leafy stems, and showy terminal flowers. The three inner and upper floral parts (petals) are much differentiated from the three smaller greenish sepals beneath; there are 6 stamens in 2 series with the anther bases prolonged into a tubular sheath, a sessile, persistant 3-lobed stigma, and fruiting capsules splitting open along the partitions *(septa),* with numerous flattened seeds.

These characters have been considered by some botanists sufficient to place the genus in a separate family, Calochortaceae. The genus is the western analogue of the Old World tulips and, for that reason, the vernacular name mariposa-tulip is perhaps preferable to mariposa-lily. Many California authorities object to the use of the name mariposa (Spanish for butterfly) except for members of the section *Mariposa.* These authorities chiefly use fairy-lantern, globetulip, pussy-ears, and star-tulip, respectively, for the subsection *Pulchelli,* section *Cyclobothra,* subsection *Elegantes,* and subsections *Nitidi* and *Nudi.* The small, fuzzy-petioled species [such as *C. coeruleus* (Kell.) S. Wats. and *C. elegans* Pursh] are often called cats-ears, pussy-ears, and bats-ears.

The generic name *Calochortus* is derived from Greek καλος (beautiful) + χορτος (forage—especially grass), referring to the beautiful flowers which run almost the entire gamut of the spectrum in color—white, cream, yellow, brown, orange, red, blue, purple, violet or a mixture, the petals aften dark spotted or dotted near the base. Many of the species are in ornamental cultivation. Credit is due David Douglas (1799–1834), the eminent Scotch botanical explorer, as pioneer popularizer of the mariposas, especially for ornamental gardening. He discovered several species and introduced them into England.

The five species annotated below are among the commonest and best known of the range mariposas, and have in general the minor forage values indicated above for the genus as a whole.

The forage value of *Calochortus* is limited, chiefly due to scanty evanescent herbage and the usual scattered and sparse stand. The plants dry up shortly after blossoming. However, early in the season, when fresh and succulent, the palatability of the herbage is good for sheep and fair for cattle. Horses, however, as a rule, nibble these plants only through accident or necessity. The bulbs or mariposas are eaten by pocket gophers and other rodents, which gather and store them for winter use; they were eaten also by Indians. Probably the bulbs of all the species are edible and those of some of them [e.g., **skyblue mariposa, *C. coeruleus* (Kell.) S.**

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FIGURE 6.—Mariposa (*Calochortus*). *A*, Northwestern mariposa (*C. elegans* Pursh), with individual flower and petal; *B*, Gunnison mariposa (*C. Gunnisonii* S. Wats.), showing flowering and fruiting tip, individual flowers, and petal with broad fringed basal gland; *C*, skyblue mariposa, or "pussy-ears" [*C. coeruleus* (Kell.) S. Wats., syn. C. *maweanus* Leichtlin in part], with individual hairy petal.

Wats., syn. *C. maweanus* Leichtlin in part, a Californian "pussy-ears"] (fig. 6) have a rich, nutty flavor when roasted.

Ownbey *(149)* recognizes 3 sections and 12 subsections of *Calochortus*. His sections are *Eucalochortus*, with more or less rounded,

3-winged fruits and a subumbellate inflorescence, the flowers often and the fruits usually nodding; *Mariposa,* with narrower and mostly 3-angled fruits, and membranous-coated bulbs; *Cyclobothra,* with fiber-netted bulbcoats and including among others, the "fairy-lanterns" having nodding, rather globular flowers.

1. **Northwestern mariposa** (***Calochortus elegans*** **Pursh**) (fig. 6), is of historical interest as the botanical type of the genus, the earliest known and described species, originally collected by Capt. Meriwether Lewis of the Lewis & Clark Expedition at the headwaters of the Kooskoosky River, Idaho. It (including its varieties) is found from the Bitterroot Mountains of western Montana, through (especially central) Idaho and southeastern British Columbia into Washington and Oregon (east of the Cascades) as far as Siskiyou County, northern California. It is one of the two (perhaps three) species of the genus found in British Columbia. It occurs in ponderosa pine woods, pinegrass and other grass weed meadows, slopes and ridges, between elevations of 2,000 and 7,000 feet—up to subalpine meadows.

It is a small plant, one of the so-called cats-ears, or pussy-ears, about 2 to 8 inches tall, with a solitary basal leaf longer than the stem; 1 to 3 (occasionally 4) erect or slightly nodding flowers with the 3 petals white or greenish white above and purplish or bluish at base, more or less densely beset and also fringe-margined with soft hairs. The glandular pit at the base of each petal is covered on its upper portion by a narrow fringed scale occupying about a third of the width of the basal "claw." The fruiting capsules are elliptical, rounded at each end, and more or less nodding.

2. **Gunnison mariposa** (***Calochortus gunnisonii*** **S. Wats.**)[6] (fig. 6) ranges from the Black Hills of western South Dakota to central Montana and south to Colorado, eastern Utah, northern Arizona, and eastern New Mexico. It has several slender often inrolled leaves and a stem about 8 to 20 inches high, from a bulb *without bulblets.* The flowers are large and showy, the white, cream-color, lilac or purplish (in one variety, yellow) petals sometimes 1½ inches long, with purple-*dotted* bases. It occurs scatteringly in sagebrush, woodland, and ponderosa pine types—up to about 7,500 feet in northern Arizona.

3. **Sagebrush mariposa** (***Calochortus macrocarpus*** **Dougl.**) ranges from southern British Columbia to northern California, northern Nevada, Idaho, and western Montana. The stems are rather stout, bluish (glaucous) up to 20 inches high and often with bulblets at the base; the linear leaves become inrolled and recurved at the tip. The flowers are large and showy, the 3 petals purple with green stripes, up to 2 inches long, the sepals elongated and narrow and the anthers slender. The fruiting capsules are linear, lance shaped, up to 2 inches long, and erect. The plant grows on

[6]The plant is named for its discoverer and first collector, Lt. John Williams Gunnison (1812–53) of the Army Engineers who (with Capt. Howard Stansbury) mapped the great Salt Lake region and met death by massacre in Utah. Gunnison County, Gunnison River, and the Gunnison National Forest in western Colorado also commemorate him.

dry plains and slopes, usually in loose volcanic soils, up to the ponderosa pine belt. Sometimes called "green-banded star-tulip."

4. **Broadfruit mariposa** ***(Calochortus nitidus*** **Dougl.,** syn. *C. eurycarpus* S. Wats.) is found in both dry and moist meadows and in the ponderosa pine type, between elevations of about 3,000 and 6,500 feet, associated with grasses, bearberry, erigeron, larkspur, lupine, spirea, yarrow, etc. Its range is southwestern Montana to southeastern Washington, eastern Oregon, and Elko County, northern Nevada. It attains a height of 1 or 2 feet, with 1 or 2 basal leaves. Inflorescence mostly in umbels of 2 to 4 large, erect, white or cream-color to lavender or purple flowers. The fruiting capsules, up to 1 inch long, are broadly winged.

5. **Sego-lily** ***(Calochortus nuttallii*** **Torr.)**[7] is the most widely distributed species of *Calochortus,* ranging, with its varieties, from the western Dakotas as far as Oregon, California, northwestern New Mexico, Colorado, and western Nebraska. The plant is one of the most conspicious and beautiful early-blooming flowers of the semidesert and is unusually abundant in Utah, where it often occurs in large, fairly dense stands. It thrives on rather dry, sandy soils on the open sagebrush foothills and valleys, as well as in open ponderosa pine stands at moderate elevations.

The bulblike roots of sego-lily were deemed a great delicacy by the western Indians. This species figured prominently in the history of the Mormon Church *(179).* When Brigham Young and his little band of followers emigrated into Salt Lake Valley in 1847, food was very scarce. It is reported that when the Mormon pioneers in Utah faced famine conditions in 1848–49 due to the inroads of crickets, drought, and frost on their grainfields, the sego-lily was an outstanding means of tiding them over *(17).* Before the flowers appear, the leaves of sego-lily are often confused with those of deathcamas *(Zigadenus* spp.), but may be readily distinguished by the rounded troughlike cross section of their U-shaped leaves, as opposed to the sharply V-shaped leaf of deathcamas *(204).*

Fawnlily *(Erythronium)*

Erythronium is a genus of low, short-stemmed herbs from deep-seated, papery-covered bulblike corms, with mostly 2 basal leaves, attractive solitary nodding flowers of various colors, 6 separate perianth segments ("sepals" and "petals"), 6 stamens with base-attached anthers, and fruiting capsules splitting when ripe in between the divisions (septa). Their forage value is largely negligible; they are seldom observed to be grazed. The corms of

[7] Sego-lily—the spelling is preferable to "sago-lily"—derives its name from the Indian word *sego* for the plant. Its specific name commemorates its discoverer, Thomas Nuttall (1786–1854), eminent English-American botanist, dendrologist, ornithologist, and naturalist [the "Old Curious" of Dana's book "Two Years Before the Mast" (*66*)], who accompanied Nathaniel Wyeth on his second expedition to the Pacific in 1834. Sego-lily is the official State flower of Utah.

some species were eaten by Indians; a number of the species are cultivated as ornamentals.

There are about 23 species of fawnlily, 4 in Europe and Asia; 3 in the Northeastern States; 1 in the Southeastern States, and 15 in the Western States. The genus is absent from Arizona and New Mexico. Applegate *(6)*, in his monograph of the western species says: "Over one third of the known species are concentrated within the limits of the old cretaceous 'Siskiyou Island' of southwest Oregon and northwest California." These plants are often called adderstongue, dogtooth-violet, glacierlily, and troutlily. The generic name (derived from a Greek word meaning *red)* was given by Linnaeus because of the red flowers of the type species (the only one known to him), the Eurasian **dogtooth fawnlily *(Erythronium dens-canis* L.)**

Perhaps the commonest of the range species is the yellow-flowered **lambstongue fawnlily *(Erythronium grandiflorum* Pursh,** syns. *E. giganteum* Lindl., *E. parviflorum* S. Wats.) (fig. 7),

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FIGURE 7.—Lambstongue fawnlily (*Erythronium grandiflorum* Pursh, syns. *E. giganteum* Lindl., *E. parviflorum* S. Wats.).

including its whitish-anthered, unequal-filamented var. ***pallidum*** St. John (to which Applegate refers var. *parviflorum* S. Wats., *not E. parviflorum* S. Wats., and *E. parviflorum* Goodding in part) and also the golden-anthered ssp. *chrysandrum* Applegate (to which Applegate refers Goodding's type of his *E. parviflorum). E. grandiflorum* ranges from Vancouver Island and southern Brit-

ish Columbia, through Washington and Oregon, to northern California as far south (along the west coast) as Mendocino County and eastward through Nevada, Utah, and western Colorado to western Montana and southern Alberta. It has a great altitudinal range from near sea level to at least 9,000 feet.

Applegate reports that the region of greatest abundance of *Erythronium grandiflorum* is probably in open ponderosa pine forests, cutover lands, prairies and cultivated fields of northern Idaho. Chesnut *(38)* reports that the Wailaki Indians of California "use the crushed corms as a poultice for boils and have a peculiar superstition that, if they wash themselves with a decoction of it, they can stop a rattlesnake from having dreams, which, they say, make them more irritable and dangerous"; the bulbs are also limitedly eaten. Unlike those of many species, the leaves of *E. grandiflorum* are not mottled; in the typical form the anthers are red.

Fritillary *(Fritillaria)*

This is a large, chiefly Asiatic genus of simple-stemmed herbs perennial from bulbs with thick fleshy scales and which often proliferate at the base into numerous rice-grainlike bulblets—whence one of the vernacular names, "riceroot." The attractive flowers are nodding, bell- or funnel-like, solitary or in racemes or umbels, with 6 similar, frequently speckled or mottled segments ("petals"), a more or less 3-lobed stigma and 6 stamens attached at their base below the ovary. The fruit is a somewhat papery oblong or ovoid capsule, splitting between the three partitions *(septa)* to discharge the flattened seeds which are arranged in two rows in each cell. The genus, so far as North America is concerned, is confined to the western part, from Alaska and western Canada southward, where about 17 species occur. Thirteen of these species occur in California, which is the American center of distribution for the genus. Many of these species are in ornamental cultivation.

The range forage significance of fritillaries may need further study. Their palatability is often reported as fair or occasionally good but their value ordinarily is negligible or small, due to scattered stands and limited amount and evanescence of herbage. The genus is called "poisonous" by Pammel *(152, p. 377)* but, to the writer's knowledge, fritillaries have never been so accused on national forest or other western ranges. Moreover, Anderson *(4)*, Gorman *(83)*, Teit *(198)*, and other authorities report the use by Indians of the bulbs and ricelike bulblets of fritillaries as food, both raw and roasted. Long *(123)* states that, although no definite case of poisoning has been found in the literature, the European *Fritillaria meleagris* L. is known to contain the bitter alkaloid *imperialine* ($C_{35}H_{60}NO_4$), which is a heart poison.

The books indicate that the generic name *Fritillaria* is derived from Latin *fritillus* (dicebox). The name dates back at least as far as the Belgian botanist Rembert Dodoens, or "Dodonaeus" (1517–85). In 1583 Carolus Clusius (1526–1609), a nearly contemporary

Belgian botanist, wrote that the name originated with an Orleans druggist named Noel Capperon. The Englishman John Gerard wrote in his *Herbal* (1597): "It hath been called Frittillaria, of the table or boord upon which men plaie at chesse." Gerard evidently referred to the common **checkered fritillary** of Europe (***F. meleagris* L.**), which has checkered spots on its "petals." Incidentally, the Latin word for dice is different, *aleae*. It is difficult for the writer to see the connection between a checkerboard pattern and a dicebox unless, to be sure, medieval diceboxes were so patterned; he wonders if there could possibly be a connection between *fritilla* (Latin for a special gruel used in Roman sacrifices) and the rice-grainlike roots of this genus. The two species briefly annotated below are perhaps the commonest, most widely distributed and best known range species.

Purplespot fritillary (***Fritillaria atropurpurea* Nutt.**) ranges from North Dakota to Nebraska, New Mexico, California, and Washington, from plains to foothills and into the ponderosa pine and aspen types, often in moist rich sites. The stems are slender, 4 to 16 inches high, leafless below, the stem leaves linear, alternate or the uppermost whorled and bear one to several flowers dark purple, mottled with yellowish green, or yellowish and thickly mottled with maroon or purplish spots.

Yellow fritillary [***Fritillaria pudica* (Pursh) Spreng.**, syn. *Ochrocodon pudicus* (Pursh) Rydb.] (fig. 8), often called "yellowbell," is a plains and foothills plant, 3 to 12 inches high, occurring from British Columbia to western Montana, Colorado, New Mexico, California, and Washington. It has 1 to 5 narrow thickish leaves, scattered or nearly whorled, and a usually solitary nodding yellow flower.

Lily (*Lilium*)

The true lilies, a spectacular group of ornamental plants, are chiefly represented in the Near East. About 14 species occur in the western range country. They are perennial herbs from scaly bulbs, with linear to narrowly oval leaves alternate, scattered or whorled; simple stems; large and showy flowers (mostly with shades of red, orange or yellow, sometimes white, often purple spotted or dotted), the 6 segments (petals and sepals) free; 3-lobed stigmas; 6 stamens with anthers attached by their middles *(versatile)*, and 3-celled, many-seeded fruiting capsules opening between the partitions *(loculicidally dehiscent)*.

The true lilies are negligible as forage plants but probably all are in ornamental cultivation. *Standardized Plant Names (111)* lists 82 species, 54 botanical varieties, and 161 horticultural varieties and clons in ornamental cultivation in this country; doubtless that list is incomplete. Stewart *(192)* reports that the lily genus is "favorable material for studies in chromosome morphology, both because of its large chromosomes and because—with the exception of the triploid ***Lilium tigrinum***—all the species reported are diploid, with 24 chromosomes." Brief notes on three representative range lilies follow.

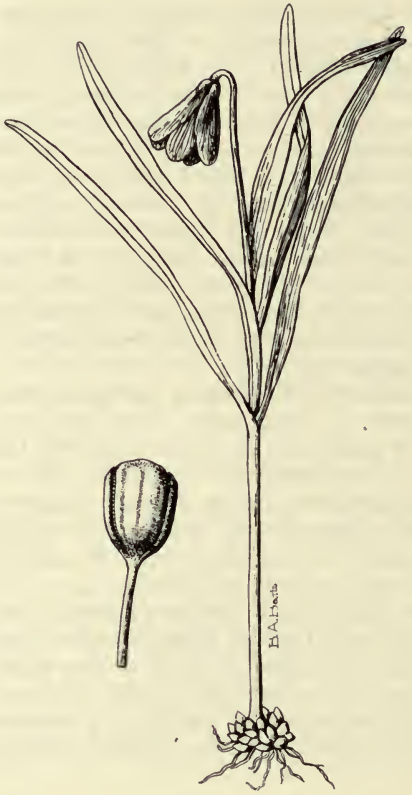

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FIGURE 8.—Yellow fritillary [*Fritillaria pudica* (Pursh) Spreng.], with fruiting capsule.

1. **Columbia lily** ***(Lilium columbianum*** **Hanson)**, also known as Columbia tiger lily and Oregon lily, is found in moist meadows, open ponderosa pine woods and the like, from Vancouver Island and southern British Columbia south to western Idaho and Humboldt and Sierra Counties, Calif., chiefly in the coastal region. It has a relatively small (1½ to 2 inches broad) ovoid bulb; a slender stem 2 to 4 feet high; leaves in whorls of 5 to 9 or more or the uppermost and lowest leaves scattered; and usually numerous nodding flowers, the reflexed segments reddish orange and purple spotted. **Ingram Columbia lily (var.** ***ingramii*** **Hort.)** of this species is named after Douglas C. Ingram, a Forest Service officer of the Pacific Northwest Region, who perished in the Camas Creek fire on the old Chelan (now Okanogan) National Forest, Wash., in August 1929. Mr. Ingram, on the side, was an outstanding field naturalist, plant collector, and lily fancier.

2. **Chaparral lily** ***(Lilium rubescens*** **S. Wats.)**, known also as chamise lily, lilac lily, and redwood lily, chiefly occurs in the coast

ranges from southwestern Oregon to Marin and Lake Counties, Calif., in chamise, chaparral, and redwood types. The smooth stems are 2 to 6½ feet high, with about 3 to 8 lilac, almost white, or rose-purple, *erect or ascending,* very fragrant funnelform flowers 1½ to 2 inches long, with golden anthers.

3. **Washington lily** ***(Lilium washingtonianum*** **Kell.)**, often called Shasta lily, one of the handsomest of American lilies, is native from the Columbia River, Oregon, to the Sierra Nevada mountains of California, mostly in rather dry chaparral types. The smooth or slightly rough stems are up to 6 feet tall, with leaves in whorls of about 6 to 12, 1½ to 5 inches long. The *horizontal* fragrant funnelform flowers, arranged in a raceme of up to about 20 flowers, are white, becoming purplish and often somewhat dotted, the segments about 3 to 4 inches long and narrowed below to a short claw. This lily does not grow naturally in the State of Washington and commemorates Martha Washington *(212).*

Alplily [*Lloydia serotina* (L.) Sweet], a member of a small genus of 4 or 5 species—all but this one confined to the Old World, is a typical arctic-alpine plant of both hemispheres, occurring in the Swiss Alps and other moist, rocky alpine situations in Europe, in arctic western North America from Alaska south to Clatsop County and the Blue Mountains of Oregon, Idaho, and western Montana and further south, in the Rocky Mountains, to northern New Mexico. It occurs in Nevada but apparently not in California. It has been described *(51)* as "a quaint little plant, 2 to 6 inches tall, the 'petals' mainly cream-white, but veined with green and purple and often stained on the back with rose." It is negligible as forage, but is occasionally cultivated as a rock-garden plant *(76).* The genus is named for Edward Lloyd, a Welsh botanist.

BUNCHFLOWER SUBFAMILY (MELANTHIOIDEAE)

This relatively small but widely distributed and important subfamily, treated by some botanists as a distinct family, Melanthiaceae, is represented in the Western States by 7 genera and about 25 species, attaining a fuller development in the East. Its members are leafy stemmed or scapose herbs, perennial from often thick and elongated, sometimes tuberous rootstocks or else from bulbs as in the genus *Zigadenus.* As is so often the case in monocotyledons, the leaves of the western range Melanthioideae are more or less grasslike except in *Veratrum,* where they tend more to the ovate type.

The flowers are mostly rather small, white, greenish or yellowish but sometimes purplish; they have a superior ovary (or in some species of *Zigadenus,* partly inferior) 3 distinct styles, 6 stamens, a 6-parted perianth, and are arranged in terminal racemes, panicles or spikes. The fruiting capsules are 3 celled and open along the partitions *(septicidally dehiscent)* except in *Narthecium* where the fruits open midway between the sutures *(loculicidally dehiscent)* and also occasionally in *Xerophyllum,* so that the

fruits sometimes appear to be 6 valved. The Melanthioideae may also be divided [on the anthers] into two groups: One with 2-celled anthers of an oblong-ovate type, and the other with 1-celled, heart- or kidney-shaped anthers.

Members of this subfamily are characteristic, as a rule, of moist to wet sites, especially in the mountains, occurring about seeps and cool springs, on mossy streambanks, in wet meadows, and the like. The genera *Schoenocaulon* and *Xerophyllum*, however, and certain species of *Zigadenus* inhabit rather dry sites. It is open to question, however, whether practically the whole family may not be regarded as essentially hydrophytic; the mesophytic and quasixerophytic species, which seem to be drought enduring, flourish also where there is abundance of moisture.

All plants of this family appear to have active chemical properties, and they are of much concern from the range standpoint. All the species have either a history as stock-poisoning plants or else are gravely under suspicion.

Swamppink Tribe (Helonieae)

The type of this tribe is the eastern **swamppink** ***(Helonias bullata* L.)**, a rather rare swamp plant, of a monotypic genus, with a spikelike raceme of pink, rose or purplish flowers 4 to 12 inches long; it is sometimes cultivated. The only western genus of the tribe is the following:

Beargrass *(Xerophyllum)*

Tall coarse perennial herbs, often called turkeybeard, from a thick woody rootstock, with linear leaves in a thick basal tuft and also, reduced, on the stems; dense terminal racemes of white flowers, and ovoid fruiting capsules which split between the partitions *(septa)* and also sometimes between them *(loculicidal dehiscence)*. There are two or perhaps three species, the type being **turkeybeard beargrass [*Xerophyllum asphodeloides* (L.) Nutt.]** an eastern species growing chiefly in the coastal pine barrens and a favorite ornamental bog plant of European gardens, indicating a natural adaptability to moist sites. The generic name *Xerophyllum*, from Greek *xeron* (dry) + *phullon* (leaf), refers to the dry, harsh rigid leaves.

Common beargrass [*Xerophyllum tenax* (Pursh) Nutt.][8] (fig. 9) —sometimes called basketgrass, elkgrass, pinelily, soapgrass, and squawgrass—is a rigid, tufted, evergreen, herbaceous perennial plant, growing up to about 3½ to 6 feet high. It is widely distributed in the mountains from British Columbia to California, Nevada, and Montana. It is typically a plant of the higher elevations, from 3,000 up to about 8,000 feet above sea level; however, it appears at sea level on the Olympic Peninsula in Washington, probably because of the cooling effect of the ocean breezes.

[8] St. John (*175*) mentions the unsuccessful efforts of Suksdorf, pioneer botanist of Washington State, to get the settlers to adopt Indian names for many native plants, among them *yei* for *Xerophyllum tenax*.

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FIGURE 9. — Common beargrass [*Xerophyllum tenax* (Pursh) Nutt.]. *Upper right,* individual flower; *below,* fruiting capsule, showing persistent styles, the 6 withering persistent perianth segments ("petals") and the 2 types of dehiscence.

Common beargrass grows in all types of soils but best in mountain meadows and on well-drained slopes and ridges. It blooms in the spring on the lower slopes and continues until snow falls around the edges of snowbanks at high altitudes. The plant appears not to bloom annually but possibly only once every 5 to 7 years; presumably this is correlated with site characteristics.

The forage value of common beargrass is slight or perhaps negligible or problematic. The harsh, forbidding foliage, if better forage is unavailable, is hardly tempting to grazing livestock but, when snow lies on the ground and the projecting stems are sometimes almost the only visible herbage, these are occasionally cropped by hungry cattle. Sheep crop the flowers and sometimes nibble at the young leaves. Cattle and occasionally sheep pull the leaves and chew off the lower white, tender part. Deer and elk eat the plant sparingly the year around, especially the more tender leaves *(204)*. However, in view of the prevailingly poisonous character of this subfamily, it would not be surprising if scientific research finds toxic properties in this plant. In this connection it is of interest that sickness and losses have been attributed to this source by cattlemen on and adjacent to the Shasta National Forest in northern California.

Formerly, the Indians bleached and dried the long, fibrous leaves of common beargrass for basketry and padding and roasted the roots for food. Frederick Pursh (1774–1820), whose early North American flora *(164)* is a classic in early American botany and who first described this species, called it *tenax* (meaning "tenacious") because "out its very tenacious leaves they (i.e., native Indians) weave their watertight baskets, which they use for cooking their victuals in." Common beargrass is sometimes cultivated as an ornamental.

When in bloom, common beargrass is one of the most conspicuous and attractive mountain flowers and has appropriately been called "The Great White Monarch of the Northwest." The flowers exude a heavy, slightly unpleasant fragrance. The flower clusters occur at the top of the stalk, are broad at the base, and taper to a blunt point. Hundreds of creamy-white flowers are closely crowded together on slender, elongated white pedicels, their long stamens giving the effect of being solid and appearing feathery. The wiry, grasslike, rough-edged leaves are from 1 to 3 feet long, green on the upper side but a pale gray underneath.

A rather dubious third species, **Douglas beargrass *(Xerophyllum douglasii* S. Wats.)**, with smaller flowers, narrower inflorescence, slightly included stamens, and somewhat heart-shaped capsules, is occasionally reported from western Montana to Oregon. Most botanists regard it merely as a form or variant of *X. tenax*.

Tofieldia Tribe (Tofieldieae)

This tribe is represented in the Far West by 2 genera and 4 species.

Bog-Asphodel *(Narthecium,* syn. *Abama)*

Narthecium is a small genus of five species: One each in Europe-west Asia, east Asia, Northeastern United States, Southeastern United States, and in the Pacific area of this country. They are perennial bog plants from fibrous-rooted rootstocks, with basal tufts of grasslike clasping *(equitant)* leaves, and racemes of small, greenish or yellowish 6-parted flowers with a somewhat 3-lobed stigma and 6 woolly stamens. The fruiting capsules are slender and beaked, with numerous tailed seeds.

The type of the genus is the Old World *Narthecium ossifragum* (L.) Huds., (syn. *Anthericum ossifragum* L.) which Fernald in the new Gray's Manual *(69)* says gets its name *ossifragum* (Latin, for bone-breaker) because it "was formerly supposed to break the bones of sheep feeding on it." Müller *(143)* and Long *(123)* mention that the plant contains the glucoside *narthecin,* has a record of poisoning cattle and that "a cat died after drinking the milk of an affected cow." The whole genus is under suspicion.

The significance of the name *Narthecium* seems to be controversial. Some say it is an anagram of *Anthericum.* Fernald *(69)* explains it as derived from Greek *narthekion,* a small chest. *Narthecium* was first published by Dr. Paul Gerhard Heinrich Moehring (the eponym of our genus *Moehringia),* a physician and naturalist of Dantzig, Germany, in 1742 but, as that was 11 years before Linnaeus' "Species Plantarum" was published, the name has no legality under the Code. Moehring states that he derived the name from Greek *narthēx,* the common giantfennel *(Ferula communis* L.) of the Old World, whose stems were used as rods in the Bacchanalian processions and by ancient schoolmasters.

Some books use the generic name *Abama* Adans. (1763) in the belief that Jussieu published *Narthecium* in 1789; however, *Narthecium* was validly published by Hudson in 1762 so that it is a year older than *Abama.* The synonymous name *Abama,* by the way, is derived from the Greek (*a-,* privative + *bēma,* Doric *bama,* footstep), signifying "unable to walk," referring to an ancient belief that this plant caused lameness in cattle.

California bog-asphodel [*Narthecium californicum* Baker, syn. *Abama californica* (Baker) Heller] occurs in springy and boggy places in mountain meadows of the ponderosa pine belt from southwestern Oregon into California. It has slender stems 1 to 2 feet high and narrow racemes of yellowish flowers. The writer knows of no record of this plant being grazed; because of the habitat it would be more likely to be taken by cattle or horses than by sheep but, in any event, it should be viewed with suspicion.

Tofieldia *(Tofieldia)*

Tofieldia, sometimes unfortunately called bog-asphodel, is a widely distributed genus of perhaps 25 species, occurring in the Arctic, North America, the Andes Mountains of South America, also Europe, Asia, and Africa, and is named for Thomas Tofield (1730–79), a British botanist. There are 3 species in Alaska, 1

species each in the Southeastern and Far Western States, and 3 species in the Eastern and Central States. Tofieldias are herbs perennial from rootstocks, with chiefly basal, more or less 2-ranked and sheathing sedgelike leaves; dense spikelike racemes or panicles of small 6-parted white, greenish or yellowish flowers with 6 stamens, 3 persistent styles, and 3-celled fruiting capsules opening along the partitions *(septa)* with the withered flower segments persisting at the base. The western range species is tall tofieldia.

Tall tofieldia, or western tofieldia ***(Tofieldia occidentalis* S. Wats.,** syn. *T. intermedia* Rydb.), ranges in marshes, wet meadows, peat bogs, and other like sites from southern and southeastern Alaska to western Montana, (Saskatchewan?), and western Wyoming and, along the Pacific, south to California. It is not known to occur in Colorado or Utah and is in Nevada only in the Lake Tahoe region, near the California border. The stems are solitary or several, 4 inches to 2 feet high, sticky-pubescent toward the top with black glands, and clothed at the base with fine short fibers (the residue of old leaves and sheaths). The flowers vary from pale greenish to yellowish white or yellow. The seeds have a tail-like appendage.

The (typically Alaskan) form known as *Tofieldia intermedia* Rydb. is smaller than *T. occidentalis,* has narrower and paler floral segments, the inflorescence is less open, the bractlets subtending the flowers are fused less than two-thirds of their length and are fixed close to the flower instead of at the middle of the flower stalk *(pedicel)* and, with the pedicels, are almost free from glandular hairs; the capsules, moveover, are more rounded and are not narrowed at the base. However, the intergradations between these two species are so numerous and confusing that most botanists today consider *T. intermedia* a synonym of the older *T. occidentalis.*

The forage values of tall tofieldia need further study. Occasional reports are made that it is taken by cattle and sheep with fair or fairly good relish, but it is quite possible that this plant has been confused with associated sedges or other plants. There appears to be no history of this genus as poisonous plants. However, because of the close relationship of these plants to known poisonous plants such as bog-asphodel *(Narthecium),* crowpoison *(Ammianthium),* swamppink *(Helonias),* bunchflower *(Melanthium),* false-hellebore *(Veratrum),* and deathcamas *(Zigadenus),* it seems safest to regard tofieldias with suspicion pending more positive knowledge concerning them.

False-Hellebore Tribe (Veratreae)

All the six known genera of this tribe possess species which are known to contain toxic compounds. Four of these genera are represented in the western range area.

Sabadilla *(Schoenocaulon)*

Drummond sabadilla ***(Schoenocaulon drummondii A. Gray)***[9] is, save for ***S. dubium*** **(Michx.) Small** (syn. *S. gracile* A. Gray) of the Coastal Plain of Florida and southern Georgia, the only species of this genus occurring in the United States. It is confined to dry plains and foothills up to the lower woodland type, chiefly in clay soils, from western Texas to southern New Mexico and south into Mexico. The plant has a narrow elongated bulb clothed with black hairlike fibers. The leaves are all basal, elongated and grasslike. The small, pale green narrow-petaled flowers occur in a terminal spikelike raceme 4 to 24 inches long.

Drummond sabadilla, although it seems to have no history as a stock-poisoning plant, should be watched on any range where it may grow in appreciable stand because of its very close relationship to **drug sabadilla [*Schoenocaulon officinale* (Cham. & Schlecht.) A. Gray,** syns. *Sabadilla officinarum* Brandt & Ratzeb., *Veratrum sabadilla* Retz.] of Mexico, Guatemala, (elsewhere in Central America?) and northern South America, especially Venezuela. Sabadilla is an official drug and insecticide *(216)*. It contains the poisonous alkaloid *sabadillin* ($C_{34}H_{53}NO_8$) and, during World War I assumed importance, especially in England in the manufacture of asphyxiating and tear-producing gas *(1)*. The seeds, which are highly toxic, contain, besides *sabadilla, cevadine,* veratric acid, etc. The plant is occasionally cultivated, but much of the commercial crop is reported to be taken from wild plants in Mexico and Venezuela *(159)*. In the latter country it is used as an insecticide for cattle and, also in an ointment, for human parasites. The powdered drug is also imported into Europe as a mordant for dyes, for tanning fine leathers, and in the manufacture of disinfectants.

Stenanthium *(Stenanthium)*

Stenanthium is a small genus of bulbous herbs, with grasslike leaves, racemes or panicles of somewhat bell-like, 6-parted flowers, 6 included stamens with kidney-shaped *(reniform)* anthers, and 3-celled, 3-beaked fruiting capsules opening along the partitions *(septa)*. Two species are eastern, one western, and there is one species each in the Western States, Mexico, and Sakhalin Island, eastern Asia. The genus seems to have no history as stock-poisoning plants, but its close relationships make it a fit object for suspicion. One eastern species **featherfleece** ***(Stenanthium robustum*** **S. Wats.),** with large dense panicles of whitish flowers, is in ornamental cultivation; some botanists consider it merely a form [forma *robustum* (S. Wats.) Palmer & Steyermark] of the other eastern species, **grassy stenanthium [*S. gramineum* (Ker) Morong].** It is taller and more robust than *S. gramineum,* with

[9]The species is named in honor of its discoverer and collector, Thomas Drummond [(1790?)–1835], Scotch naturalist, nurseryman, and explorer, who was associated with Franklin, Richardson, and other early arctic-America explorers, and who was one of the first botanical collectors in Texas.

broader leaves, denser panicles, and erect instead of nodding fruiting capsules.

Western stenanthium [***Stenanthium occidentale*** **A. Gray,** syn. *Stenanthella occidentalis* (A. Gray) Rydb.], sometimes called featherbell and mountainbell, ranges in moist or wet places, such as streambanks and high mountain swamps, in the ponderosa pine belt to timberline, from British Columbia and Alberta to western Montana and south, through Washington, Idaho, and Oregon, to the mountains of Trinity County, northern California. It is a rather attractive plant in bloom, with narrow, mostly basal grass-like leaves, a slender stem 6 to 24 inches high, with a raceme of nodding, rather bell-like, brownish or dull purplish flowers appearing in July and August. It is not known to be grazed.

False-Hellebore *(Veratrum)*

There are perhaps 9 valid species of *Veratrum* in this country, 5 in the West, 3 in the East, besides one endemic in Florida. At least 45 species have been proposed from the Old World, especially in Japan, China, Korea, Mongolia, and Siberia. The genus undoubtedly needs monographing by a conservative botanist.

The false-hellebores are tall, robust herbs, with unbranched leafy stems arising from a short, thick, brownish or black, poisonous rootstock,[10] which is sometimes covered with a layer of coarse fibrous dead leaf sheaths of previous years. The true roots, descending from the rootstock, are few or numerous, "ropy" branched, and dark colored externally. The blackish color of the roots and rootstock conceivably might account for the generic name *Veratrum,* as that word seems to be derived from Latin *vere* (truly) + *atrum* (black). The alternate leaves are large, broad—of an ovate or lance-ovate type—coarse, plaited or folded, heavily ribbed, stemless or contracted to a broad sheath at the base, and are gradually smaller and narrower near the top of the stalk.

The numerous and relatively large flowers are dull white, greenish, yellowish or purplish, borne in showy terminal and elongated panicles. These plants have 6 persistent petallike parts and 6 stamens; the capsule is 3-celled, each cell containing several to many broad-winged seeds. The lower flowers are often male staminate) only or the staminate and female (pistillate) flowers may occur on separate plants.

The confusion between true **hellebore** ***(Helleborus)*** of the buttercup family (Ranunculaceae) and the liliaceous false-hellebore *(Veratrum)* genus is very ancient. Greek physicians used the rootstocks of "hellebore" *(helléboros)* for various purposes, but primarily as a remedy for insanity, and the Greek verb *helleboriáo* (literally, "to need hellebore") was applied to a person who was losing his mind. These oldtime medical men distinguished two

[10]The toxicological literature on this genus is extensive, among which the following may be considered as representative: Chesnut and Wilcox (*39, p. 119–121*), Pammel (*152, p. 381–382*), Hall and Yates (*88, p. 243–244*), Glover and Robbins (*82, p. 25–27*), Gail and Hahner (*77, p. 5–6*), Sampson (*176, p. 38–40, 58–59*), Fleming (*72, p. 35–36*), and Muenscher (*141, p. 45–48*).

chief types of hellebore: **Christmas-rose,** or **black hellebore** ***(Helleborus niger* L.)** and **"white hellebore,"** or **white false-hellebore** ***(Veratrum album* L.)**. It seems probable that the *Veratrum* of the ancient Romans was *Helleborus niger,* at least in large part, which, incidentally, has blackish roots. To avoid confusion, it seems desirable to restrict the English name "hellebore" to the plant genus now known as *Helleborus,* and to call the genus now known as *Veratrum* "false-hellebore."

The common name "cornlily" indicates the similarity of false-hellebore leaves and their stalk arrangement to corn; sometimes heard for these plants are the names "cow-cabbage," "rarebell," and "wild corn"; the name skunkcabbage, no doubt, alludes to the general resemblance of the young plants to the true **skunkcabbage** [***Symplocarpus foetidus* (L.) Nutt.,** syn. *Spathyema foetida* (L.) Raf.], a foul-smelling, broad-leaved herb of the Eastern United States and eastern Asia and belonging to the arum family. In the West "skunkcabbage" is also applied to another bog plant, the related **American yellow-skunkcabbage** ***(Lysichitum americanum* Hult. & St. John)**, ranging from southern and southeastern Alaska to British Columbia, Idaho, western Montana, the Yellowstone National Park or northwestern Wyoming and south, through Washington and Oregon, to California. In the past this species has been confused with the related ***L. camtschatcense* (L.) Schott** of northeastern Asia *(101)*.

The roots of **American false-hellebore** ***(Veratrum viride* Aiton)**, an eastern species, and of **white false-hellebore** ***(V. album* L.)** of Europe yield a powerful (and more or less toxic) drug which is used as a heart and arterial sedative *(147)*. This drug contains various related alkaloids, including *cevadine* ($C_{32}H_{53}NO_8$), which has a burning taste, produces violent sneezing, and dilates the pupils; *jervine* ($C_{26}H_{37}NO_3$), which is mildly toxic, and *veratrine,* which is a mixture of alkaloids, chiefly *cevadine and veratridine* ($C_{37}H_{53}NO_{11}$). *Veratrine* reduces the pulse power without reducing frequency, but an overdose results in very low pulse, nausea, and muscular prostration. Probably the poisonous effect on livestock is similar although possibly more marked. There is chemical evidence that similar properties reside in the roots of western species of false-hellebore. Incidentally, the physiological effect of black hellebore *(Helleborus niger)* is exactly opposite, as it is a heart stimulant.

Western false-hellebore ***(Veratrum californicum* E. Durand,** syn. *V. speciosum* Rydb.) (fig. 10), the most common and widely distributed of the western range false-hellebores, occurs from southern British Columbia to California, New Mexico, Colorado, and western Montana and is, therefore, native to all eleven Far Western States. In the (especially older) literature it is often confused with the Old World ***V. album*** and the eastern ***V. viride,*** which are distinct species. The species, always conspicuous when a feature of the landscape, is one of the largest herbaceous perennials of mountain meadows, marshy bottom lands, streambanks, and the like. It is at its best as regards size and adundance in such sites, al-

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FIGURE 10.—Western false-hellebore (*Veratrum californicum* E. Durand).

though it also does well in shallow and coarse soils of moist or springy slopes and flats.

Not infrequently this herb invades and dominates eroded but moist flats and slopes, and in serious cases of depletion is sometimes one of the last perennial plants of the meadow association to disappear. It ordinarily forms small irregular clumps and, as a rule, inhabits open sunny sites. These clumps in some cases grow together to form extensive patches, almost to the exclusion of other herbaceous vegetation. The plant is mainly a native of the higher mountains, usually being most abundant above 5,000 feet elevation, from the ponderosa pine belt to timberline. It has been collected at 3,000 feet in northwestern Oregon and at 11,000 feet in Colorado. It appears as soon as the snow is gone and reaches maturity within about 60 days.

The value of western false-hellebore as a forage plant for domestic livestock is subject to considerable variation; investigators and collectors may report it as excellent, unpalatable, or poisonous. The roots and seeds of this plant are highly poisonous but are seldom touched by livestock under range conditions; the herbage, when fresh and succulent, is undoubtedly more or less poisonous. Horses and cattle can become very sick by eating any considerable quantity of the fresh leaves; a few cases are on record also of human beings having been unwittingly poisoned by using the fresh leaves for "greens." After frost and after wilting, when the leaves are turned brownish or reddish, the herbage appears to be harmless and sheep will sometimes pick off the leaves or even eat the plant down to the ground, especially the foliage and the pithy part of the stalk, so that it then may be valuable sheep forage and, to a less extent, for cattle.

In Colorado the species is practically worthless for cattle and only poor forage for sheep, but in Montana and northern Idaho it is fairly good for sheep. The herb is little used and rated as poor forage for both cattle and sheep in the Intermountain States and the Southwest. On properly grazed ranges in California and parts of the Northwest it is fairly good for sheep, fair for cattle, and worthless to poor for horses, with the use largely limited to spring and fall. Sheep relish the young shoots, but like other classes of livestock avoid the plant throughout the main growing season, but graze it again after the foliage has been frosted and has become dry and brown. The use of western false-hellebore is very much greater near bed grounds or driveways and where sheep or cattle concentrate. At these areas and on overstocked ranges, the use is frequently so complete that, by midsummer, the entire plant is eaten to within a few inches of the soil. This concentrated use, however, is usually regarded as a sign of serious overstocking. In Montana, and probably elsewhere, elk and deer graze the plant with impunity, at least during the fall and winter.

The poisonous materials are concentrated in the root and the young shoots *(89)*. As the plant matures, the poison decreases in the aerial parts, so that the species is practically harmless at maturity or when killed by frost. Although all kinds of livestock may

be poisoned, it is generally agreed that the danger is slight where there is plenty of other forage and the animals have normal appetites. Poisoning usually occurs under some abnormal condition, such as at driveways, bed grounds, overgrazed ranges, or gathering pastures, where hungry animals eat freely of this plant before grazing other forage. Poisoned animals usually recover in a few days, although in very serious cases they may die in a few hours. However, on properly grazed ranges, or where western false-hellebore is mainly a fall feed, few animals are poisoned, and deaths are almost unknown. Vansell and Watkins *(205, pp. 168–170)* report that blossoms of western false-hellebore sometimes cause heavy losses among honeybees, and that numerous ants, beetles, flies, and other insects are killed by the flowers. Kennedy and Doten *(112, p. 142)* mention the use of the flowers by sheep during June and July on summer ranges of western Nevada.

The seeds are fatal to chickens, which occasionally pick them up. Lambs are often poisoned by eating the large buds and the crown when the plant first comes up in the spring. The symptoms of poisoning include slobbering, throat burn, vomiting, extreme heart depression, weak pulse, labored respiration, and general paralysis. Death, when fatal results ensue, is from asphyxiation; loss of sight frequently occurs also. It is probable that the roots have the medicinal properties common to the genus. Remedies prescribed are stimulants, such as digitalis, strychnine, atropine, spirits of glonion, etc. Tannic acid with alcohol, permanganate of potash, ammonia, raw linseed oil, lard, and soda are also reported to have been administered with good results. Laudanum, morphine, and chloral hydrate are used to alleviate pain. Warm water is administered to smaller animals to help vomiting and purging.

Western false-hellebore is a very distinctive plant, being stout and up to 7 feet tall, with large, strongly veined, stemless leaves and a long, showy, terminal flower cluster consisting of numerous dull, white flowers. The leaves are frequently punctured by insects and, as the season advances, tend to lose their shape and color. On favorable sites, however, the foliage often remains green until frost. After frost the plant turns brown and dry so that any such disturbance as wind creates a harsh rustle of the leaves *(204)*.

The roots of the related eastern *Veratrum viride*, used as a commercial insecticide, are gathered in the Appalachian Mountains, and it is of interest to note that *V. californicum* is now being exploited for that purpose. Supervisor Thomas *(200)* of the Mendocino National Forest reported (August 12, 1952) as follows:

"Quite by accident it was found that the root of this plant had particular value in the preparation of a new drug used to combat high blood pressure. This new drug was discussed in a feature article in a recent issue of the Saturday Evening Post. Experiments were carried out in the harvesting of this product during the 1951 season and also in preparation of the medicine. These experiments were so successful that the Riker Laboratories of Los Angeles applied to the Forest Service for a permit to harvest 10,000 pounds of the root during the 1952 season. An area of considerable size southwest of Plaskett Meadows has been laid out and the work is being done by Ernest Yockey under contract with the Riker Laboratories. The collection work is being carried out in such a way as to minimize erosion. After the roots have been harvested,

the area will be sown to native grasses, which should improve the carrying capacity for livestock and also reduce the danger of erosion. It is expected that these sales will increase in future years and that many of our mountain meadows will be improved as a result of this type of sale."

Eschscholtz false-hellebore [*Veratrum eschscholtzii* A. Gray, syn. *V. eschscholtzianum* (Roem. & Schult.) Rydb.][11] ranges from Alaska to Oregon, Idaho, western Montana, and Alberta; it is in British Columbia but doubtfully in Yukon. It occupies wet sites, chiefly subalpine or subarctic and sometimes wooded swamps. It is a thick-stemmed, thick-rooted herb 3 to 6½ feet high, with large, mostly oval or oblong leaves 3 to 12 inches long, and green or greenish flowers subtended by leaflike bractlets often equaling or surpassing the flowers. When fresh, all parts of the herbage are more or less acrid and poisonous; the roots and seeds are doubtless highly toxic. After frost the leaves are stripped off, especially by sheep, with apparent impunity. Sheep are reported to have been made "temporarily sick" after eating the plant to a considerable extent in summer.

It is probable that the roots of *Veratrum eschscholtzii* may have medicinal or insecticidal properties similar to those of the eastern *V. viride* Aiton, with which it is frequently confused in the literature. The two species have entirely distinct ranges and there are a number of botanical differences; for example, *V. eschscholtzii* has hairier leaves, shorter stamens, longer floral bracts, and the lower panicle branches are longer and more drooping. It is also frequently confused with *V. californicum* E. Durand, which has largely a different range, nondrooping and denser panicles, nonfoliaceous floral bracts, and paler flowers with broader segments ("petals").

Fringed false-hellebore *(Veratrum fimbriatum* A. Gray), apparently confined to the California coast in Sonoma and Mendocino Counties, is interesting because of the conspicuously fringed floral segments, or "petals." Taylor *(197)* found that plants of this species dug during or shortly before initial top growth in early spring contained nearly twice as high percentages of crude alkaloids as were found in similar plants dug in July.

Deathcamas *(Zigadenus,* syns. *Anticlea, Toxicoscordion, Zygadenus)*

Aside from more obvious synonyms and names clearly referable to other genera, 38 species of *Zigadenus* have been proposed, 4 from Mexico and Central America, 2 from Japan, 1 from Siberia, and the remainder from the United States. Of these 31 native United States species, it is probable that more conservative botanists would not accept as valid more than about 15. The genus is

[11] Named after Johann Fredrich Eschscholtz (1793–1831), who accompanied, as surgeon and naturalist, the celebrated Russian navigator and explorer, Otto von Kotzebue (1787–1846)—after whom Kotzebue Sound on the northwest coast of Alaska is named—on some of his expeditions. Jepson (*104*) and Eastwood (*62*) have given accounts of Eschscholtz's plant collections in California.

widely distributed in North America from New Brunswick to Alaska and south to Florida and Guatemala. Deathcamas is represented by about 10 species in the 11 Far Western States, as well as on rangelands in Texas, Kansas, Nebraska, and the Dakotas. These species occur from slightly above sea level (about 600 feet in California) up to 12,000 feet in Utah. They grow in almost every type of soil and flourish in both dry and moist situations, sometimes actually living in water. Some species grow in clumps or patches, but the majority are mixed with a variety of other herbaceous plants. Usually most species seek full sunlight, but a few prefer shaded sites.

These plants, sometimes known as "poison-camases," "poison-segos," "poison-soaproots," "white-camases," "zygadene," and erroneously as "lobelias," are most commonly called deathcamases, to distinguish them from the somewhat similar, edible (and mostly blue-flowered) camases *(Camassia* spp., syn. *Quamasia* spp.) with which they are often confused. The generic name *Zigadenus*[12] is derived from the Greek words ζυγον (yoke) + άδήν (gland) and refers to the characteristic, yoked, or paired petal glands of the type species, **Atlantic deathcamas *(Z. glaberrimus* Michx.)** of the Eastern States. In the western species these two glands are united into a single gland found at the base of each flower *(perianth)* segment.

Deathcamases are perennial herbs from bulbs and/or rootstocks *(rhizomes)*, with a leafy or leafless stem varying in height from a few inches to 4 feet. The plants are smooth *(glabrous)* with long, narrow, grasslike leaves arising from the base; sometimes the leaves and stems are covered with a whitish bloom which rubs off easily. The flowers are greenish white or yellowish in color, being set rather closely in terminal racemes or panicles and are either perfect or have male and female flowers as well (imperfect). The flower clusters elongate as the plant matures. The six similar floral segments *(perianth)* are divided to the base and bear one or two glands. These flower parts wither but persist on the plant until the fruiting capsules dehisce and the seeds are dispersed. The 6 stamens have 1-celled anthers and are either free to the base or attached to the petallike floral segments; they are about the same length as the segments. The styles are distinct to the base, and the 3-lobed and 3-celled capsule splits from the top along the 3 partitions, releasing the numerous angled seeds.

Rydberg *(170)* in 1903 revived Kunth's genus *Anticlea* and published a new segregate *Toxicoscordion*, stating that, for consistency, *Zigadenus* should be divided into these three genera: (1) Plants with a rootstock and two glands *(Zigadenus);* (2) plants with a bulb and single gland, ovary wholly superior *(Toxicoscordion);* (3) plants with a bulb and single gland, ovary partly inferior *(Anticlea);* some species of *Anticlea* have the gland so deeply lobed as almost to appear double. More conservative botanical opinion, however, prefers to regard these characters as of sec-

[12]The spelling *Zygadenus* is preferable etymologically and commonest in literature but, according to the Code of nomenclature, Michaux's original spelling *Zigadenus* should be used.

tional or subgeneric weight only, and to consider *Anticlea* and *Toxicoscordion* as synonyms of *Zigadenus*.

Presumably all species of *Zigadenus* are more or less toxic both for animals and man. The most common and important western species are probably **grassy deathcamas (*Z. gramineus* Rydb.), meadow deathcamas (*Z. venenosus* S. Wats.), foothill deathcamas [*Z. paniculatus* (Nutt.) S. Wats.]**, and **mountain deathcamas (*Z. elegans* Pursh)**. Of these grassy and meadow deathcamas are the most dangerous. The more virulent species of deathcamas cause the majority of sheep losses from poisonous plants on spring and early summer ranges because they are green and succulent far in advance of most others plants *(129, 133)*. Plants of this genus are usually dried up before the sheep reach the higher summer ranges, and hence, as a rule, are not then a source of temptation to that class of livestock. Cattle are seldom poisoned unless forced to graze on heavily infested areas where other forage is scarce. Horses rarely, if ever, eat deathcamas.

Marsh *(129)* gives the symptoms of deathcamas poisoning as frothing at the mouth, nausea with vomiting, great weakness accompanied sometimes with nervousness and resulting in collapse of the animal, which may lie without food for hours, or even days, before death. White permanganate of potash, aluminum sulfate, and bleeding have been recommended *(39, 196)* as remedies for deathcamas poisoning, the only practical defense or control, under range conditions, is to keep the animals away from heavily infested areas *(131)*. All parts of these plants are more or less toxic and sometimes very small quantities will produce injury. The mature seeds are especially toxic but, fortunately, the plants are dry and not very palatable at the time of seed dissemination *(131, 146)*.

Early western explorers frequently mentioned the poisonous deathcamases and their likeness to camases, whose edible bulbs were used extensively as food by the Indians. Despite the fact that the Indians were familiar with the danger in deathcamas, many cases of poisoning occurred among them. The Indians believed that deathcamas bulbs possess medicinal value. Chemical analyses *(94, 124)* have shown the presence of mixed alkaloids which hasten the heartbeat and make it irregular, slow the respiration, cause convulsions, and have a powerful purgative, emetic, and diuretic action; also of an alkaloid called *zygadenine* ($C_{39}H_{63}NO_{10}$) which behaves in general very much like the powerful heart-depressant *veratrine* ($C_{32}H_{19}NO_{11}$), a group of poisonus substances frequently occurring in plants of the bunchflower family and which apparently does not cause convulsions *(124)*. Additional toxic alkaloids have been isolated from deathcamases by Prof. Jacobson of the Nevada Agricultural College and others, and the toxicological chemistry of these plants must still be regarded as in the investigative stage.

At certain stages of growth, it is sometimes difficult to distinguish deathcamas from such related but harmless plants as camas *(Camassia)*, onion *(Allium)*, brodiaea *(Brodiaea)*, and mariposa

(Calochortus). Deathcamases often grow in association with onions and brodiaeas, or "wild hyacinths." During the early spring, when these plants are about 3 to 4 inches high, they all look very much alike. Onions can be identified easily by noting the strong characteristic onion odor. If the onion odor is not present and if, upon cutting a cross section of the leaf, the midrib is distinctly hollow, forming a hollow tube the length of the leaf, the plant may be a brodiaea.

Camases usually are in bloom in the early spring and, as nearly all of them have blue or bluish flowers, they are not likely to be mistaken for deathcamas. After both camas and deathcamas are in fruit, it may again be somewhat difficult to distinguish between them. The leaves fold up lengthwise in deathcamas, while camas leaves remain flat. The mature capsules of deathcamas are usually smaller, more pointed and beaked, narrower in proportion to the length, and split along the partitions separating the 3 cells, whereas the ripe capsules of camas split loculicidally down the midrib on the back of the 3 cells. The mariposas (including sego-lily) are easily distinguished as the majority of them have only one or two basal leaves.

Mountain deathcamas [*Zigadenus elegans* Pursh, syns. *Anticlea elegans* (Pursh) Rydb., *Z. chloranthus* Richards., *Z. coloradensis* Rydb.] ranges from Alaska south to eastern Oregon, Nevada, Arizona, New Mexico, Colorado, western Montana, and Manitoba. This is a species mainly of wet mountain meadows, occasionally 40 inches tall, with relatively large and showy, whitish, cream-colored or yellowish flowers, the perianth segments ("petals") about ⅜ inch (9–10 mm.) long, the basal glands reverse heart shaped *(obcordate)*, ovary partly inferior, the middle floral bracts thin *(scarious)* margined and tipped, and the fruiting capsules about twice as long as the flowers. It is often confused in literature with **white deathcamas *(Z. glaucus* Nutt.)**, a wholly eastern and midwestern species, which is closely related but quite distinct. Marsh and Clawson *(136)* found that mountain deathcamas is only about a seventh as toxic as *Z. gramineus* and "while it may poison livestock (it) probably does little or no damage under practical range conditions."

Grassy deathcamas *(Zigadenus gramineus* Rydb., syns. *Toxicoscordion gramineum* Rydb., *Z. intermedius* Rydb.) ranges from Saskatchewan to South Dakota, Colorado, Utah, Idaho, and eastern Washington. It appears to be absent from Oregon, California, Arizona, and New Mexico. It is a smooth bulbous plant 8 to 14 inches high—rarely as low as 4 inches or as high as 20 inches, the linear leaves 4 to 8 inches long and *all provided with distinct membranous sheaths;* the light yellow flowers have the 3 *long-clawed,* ovate, blunt-tipped petals somewhat heart shaped *(subcordate)* at base, the 3 lower floral segments *(sepals)* broadly ovate, blunt tipped and very short clawed at base; the margins of the basal glands are *not sharply defined;* the ovary is wholly superior.

The species occurs on hills and meadows between elevations of about 4,000 and 7,000 feet, usually in sandy or gravelly soils; it is

found in scattering stand in sagebrush and open park areas and, to a lesser extent, in open aspen and high benchlands. It was long confused with the better known meadow deathcamas *(Zigadenus venenosus)* and is now known to be even more poisonous. McLaughlin *(126)* found that an intravenous injection of an extract of this plant resulted in a respiratory inhibition in sheep which, in large doses, caused a form of asphyxia. Marsh and Clawson *(129, 130)* reported it as the most dangerous of all species of deathcamas.

Foothill deathcamas [*Zigadenus paniculatus* (Nutt.) S. Wats.] (fig. 11), sometimes called "panicled deathcamas," "panicled zygadene," and "sandcorn," ranges from Saskatchewan and Montana to northwestern New Mexico, northern Arizona, Nevada, California (largely on the east side of the Sierra Nevada), Oregon, Washington, and Idaho. It is a fairly stout perennial herb, occasionally as much as 30 inches high, from a large bulb. The sheathing leaves are 6 to 16 inches long, mostly from or near the base, relatively broad (up to 10 mm., or $\frac{2}{5}$ inch wide). The flowers, pale yellow or greenish or yellowish white, are small, numerous, in a dense terminal panicle; the perianth segments are small (not over 5 mm., or $\frac{1}{5}$ inch) long, abruptly contracted into a short claw and sometimes almost heart shaped *(subcordate)* at base, rather sharp tipped, the upper margins of the obovate basal glands *thin,* toothed, and not sharply defined; the stamens are exserted and the ovary superior.

The plant grows mostly on dry open hillsides between elevations of 2,000 and 9,000 feet, occasionally on flats; its typical habitat is loose sandy, gravelly or even rocky sites, but it is sometimes found in moist to wet loamy or even clayey situations, generally scattered and rather sparse but occasionally growing in a dense stand. As a general rule livestock will not touch this plant except when other feed is scarce. Losses are most apt to occur early in the spring, for this is one of the first plants to appear. Marsh and Clawson *(129, 130)* report that, although this plant is only about one-third as poisonous as *Zigadenus gramineus* and *Z. venenosus,* it "causes serious losses of sheep, more particularly in Utah and Nevada."

Meadow deathcamas [*Zigadenus venenosus* S. Wats., syn. *Toxicoscordion venenosum* (S. Wats.) Rydb.] is found from British Columbia to California, Utah, Nebraska, and South Dakota, its altitudinal range extending from 1,400 to 8,000 feet. The species prefers rich, moist bottom lands and lower foothills, but sometimes grows on rocky sites. This plant does not ordinarily appear in pure stands, but is very plentiful on some overgrazed ranges. It is a smooth, bulbous perennial herb about 10 inches to 2 feet tall; the upper leaves are *without sheaths;* the inflorescence, about 4 to 8 inches long, is usually a simple raceme, elongating in fruit. The small greenish or yellowish flowers, appearing during May and June, have both sepals and petals *distinctly clawed* and more or less heart shaped *(subcordate)* at base, the basal glands with a *thick* toothed margin. Seed dissemination is largely in July and August. The specific name *venenosus* is a Latin word meaning poisonous.

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FIGURE 11.—Foothill deathcamas [*Zigadenus paniculatus* (Nutt.) S. Wats.]. Flowering panicle at right; part of fruiting stalk at left.

Meadow deathcamas is one of the most toxic of our western range plants *(132)*, probably the best known of all the deathcamases, and is responsible for the loss of thousands of sheep. It is particularly dangerous on early spring ranges when it furnishes green, succulent feed in advance of many other plants. The best way to prevent losses is to herd the sheep away from the areas which are heavily infested. Cultivation will kill meadow deathcamas, but good range management is probably the most practical method of permanent control, especially if supplemented by the seeding of suitable range grasses to crowd out the meadow deathcamas. Sheep are not likely to eat the plant if plenty of other forage is available. Losses seldom occur on the high summer range, as there is then an abundance of other succulent forage and the meadow deathcamas plants become dry and unpalatable before the sheep arrive.

Fremont deathcamas ***(Zigadenus fremontii* Torr.,** syn. *Z. douglasii* Torr.), named for its discoverer, "The Pathfinder," General John Charles Frémont, is a chiefly Pacific Coast Range species from the Coquille River, Coos County, southwestern Oregon, south to at least San Diego, Calif. It has large flowers for the genus, the white or yellowish floral segments often being about one-half inch long. Bailey's Cyclopedia *(8)* lists it as probably the most promising species of the genus for ornamental cultivation. Marsh, Clawson and Marsh *(133)* list it as poisonous, and a report from the Lassen National Forest, Calif., states that local stockmen claim it to be "*deadly* poison, the bulb especially" for both sheep and cattle.

SMILAX SUBFAMILY (SMILACOIDEAE)

This subfamily, considered by some botanists as a distinct family, is represented in this country by the following genus:

Smilax, or Greenbrier *(Smilax)*

This is a very large genus, chiefly occurring in tropical America and Asia. Most of the species are woody, often spiny and prickly vines arising from thickened often tuberous rootstocks and climbing by tendrils from the leafstalks *(petioles)*; the fruit is a berry. There are two species only in the western range country, **California smilax or greenbrier** [***Smilax californica* (A. DC.) A. Gray**] of California and Oregon, a woody vine, and the herbaceous **carrionflower** ***(S. herbacea* L.)**, which is found over the greater part of the United States and occurs in the Rocky Mountain and Great Plains regions, as well as in some areas of the East, in the much shorter-peduncled and woolly-veined ***S. herbacea* var. *lasioneuron* (Hook.) A. DC.** [syns. *S. lasioneuron* Hook., *Nemexia lasioneuron* (Hook.) Rydb.].

The western smilaxes, or greenbriers, are of no or very limited forage value for domestic livestock, although hogs will sometimes root up and eat the rhizomes. Some birds and rabbits will eat the berries and deer may crop the leaves. The eastern species have about the same values except that **laurel smilax or greenbrier**

*(**Smilax laurifolia* L.)** has been reported from southwest Georgia as highly palatable to cattle. To the woodsman smilaxes are often an egregious pest because of their spininess and impediment to progress.

Tropical American species of *Smilax,* such as **Mexican sarsaparilla *(S. aristolochiaefolia* Mill,** syn. *S. medica* Cham. & Schlecht.) and **drug sarsaparilla *(S. officinalis* Kunth),** are the source of commercial sarsaparilla. Certain Asiatic species, such as **Java smilax *(S. macrocarpa* Blume),** and **Ceylon smilax *(S. zeylanica* L.)** are being studied *(64)* for their apparent medicinal value in uremic poisoning.

IRIS FAMILY (IRIDACEAE)

The iris family, closely allied to the lily family, is composed of herbaceous plants perennial from (often acrid) rootstocks *(rhizomes),* corms or bulbs. The leaves are relatively narrow, parallel veined, equitant (i. e., overlapping in 2 rows); the flowers (often large and showy) consist of 3 petals, 3 sepals, 3 stamens alternating with the petals, and a more or less inferior ovary with a usually 3-lobed stigma. The fruit is a 3-celled capsule splitting between the partitions *(loculicidally dehiscent),* with many (often large) seeds, the withering perianth (petals and sepals) falling off from the summit. There are four range genera of the family, provided (as possibly the majority of botanists agree) that *Hydastylus* and *Nemastylis* be regarded as distinct genera and provided that *Olsynium* and *Oreolirion* be regarded as synonyms of *Sisyrinchium.* The family appears to be relatively unimportant on the range, though the members need further study from the range viewpoint. Iridaceae include many important ornamentals; for example, *Crocus* and *Gladiolus,* as well as *Iris,* belong to this family.

Iris *(Iris)*

Iris is an enormous, widespread genus, with perhaps 15 valid species in the western range area, 12 of which are confined to the Pacific region. Other common names are flag, flag-lily, fleur-de-lis, snake-lily, and waterflag. Generally, irises are found in moist to wet sites, or in situations where plenty of moisture is present early in the season during the main growth period, despite that such sites subsequently become very dry. However, the distribution of irises in the West is spotted rather than general, although these species frequently are so abundant on favorable sites that they form nearly pure stands.

In general the palatability of irises to domestic livestock is zero. They are sometimes important obstacles to range improvement, in that they tend to increase on overgrazed areas adapted to their growth, and when once established greatly retard the regeneration of palatable forage species. The rhizomes of some species are known to be poisonous and, if ever eaten, would be a source of danger.

The genus is of great commercial ornamental importance. The American Iris Society has recognized some 19,000 named commercial varieties and hybrids which have been developed through intensive cultivation, and practically all natural species are in cultivation *(111)*.

The Indians formerly used the tough, flexible fibers from the leaf margins of certain species, such as **Oregon iris** ***(Iris tenax* Dougl.)**, in making strong twine for snares and nets. They also used the rhizomes, or rootstocks of **blueflag iris** ***(I. versicolor* L.)**, a widespread species in the Eastern United States, as a remedy for stomach disorders. Henkel *(93)* states that the Indians are reputed to have grown this plant for its medicinal value and that both Indians and whites used an extract of the rootstock of this species as an alterative, diuretic, purgative, and as a remedy for dropsy.

The rootstock is listed as an official drug in the United States Dispensatory *(147)*. In 1895, Rusby *(169)* reported that the rootstocks of blueflag iris contain *irisin* ($C_6H_{10}O_5$), a starchlike compound, an oleoresin, and an apparently toxic glucoside *iridin* ($C_{24}H_{26}O_{13}$). The rhizome in the fresh state possesses considerable potency as a cathartic and emetic. It has no odor, but the taste is acrid and nauseous. In 1911 Power and Salway *(163)*, in further analysis of the roots of this species, disclosed that the principal compounds are yellow oil, isophthalic acid, salicylic acid, tannin, sugar, and resins containing fatty acids.

In addition to *Iris versicolor*, the rootstocks of four other iris species are listed as official drugs *(216; 111, p. 197)*, viz: **German iris** ***(Iris germanica* L.)**; **orrisroot iris** ***(I. germanica* var. *florentina* Dykes**, syn. *I. florentina* Ker *not* L., the latter an uncertain name); **sweet iris** ***(I. pallida* Lam.)**, and **Virginia iris** ***(I. virginica* L.)**. Commercial orrisroot (most of which is imported from Italy), used in medicine, as a sachet powder, for dry shampoos, and for cleaning teeth, is derived from the rhizomes of orrisroot iris and sweet iris, mentioned above. The seeds of **yellowflag iris** ***(I. pseudacorus* L.)**, an Old World species naturalized in the country, have been used as a substitute for coffee.

By far the commonest and most widely distributed western species of this genus is **Rocky Mountain iris** ***(Iris missouriensis* Nutt.)** (fig. 12), which ranges from North Dakota to British Columbia, southern California (Pacific range is mainly east of Cascades and Sierra Nevada Divide), and New Mexico. It is the only native iris in the entire Rocky Mountain area unless one or two segregates of it are accepted. It is a perennial herb from thickened, dark, fibrous-coated, underground rootstocks. The rather slender stems are 8 to 20 (occasionally 40) inches tall, leafless or with but a single leaf above the middle; the showy, pale blue flowers are subtended by two rather broad and contiguous, thin pale and dry *(scarious)* bracts, the flower tube narrowed below and *short* (under ½ inch).

The plant is chiefly found in bottom lands or moist situations, in meadows and parks, at elevations upward to 10,000 feet. It generally grows in small clumps or patches but, under favorable con-

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FIGURE 12.—Rocky Mountain iris (*Iris missouriensis* Nutt.).

ditions, may occur in dense, nearly pure stands of considerable size. However, it also frequently grows in such sites as gravelly hillsides which dry out during the summer. This species flowers from May to July, depending on latitude and elevation. If moisture is available the plants remain green throughout the summer, otherwise they dry up in midsummer after seed matures.

Rocky Mountain iris is ordinarily worthless as a forage plant but, when its stand is increasing, it may be an indicator of overgrazing, as its robust underground (undoubtedly more or less poisonous) rootstocks enable it to withstand trampling and to spread rather rapidly when other vegetation is weakened. However, it has been reported as good bear feed on the Santa Fe National Forest (New Mexico) and has been noted as nibbled after frost on the Sitgreaves National Forest (Arizona). This species, when once extensively established, greatly retards the revegetation of the range by more palatable plants. It is a good soil binder but its characteristic habitats, moist rich soils, are potentially capable of supporting other plants of equal soil-holding qualities and of greater forage value.

Coville *(47)* found that Klamath Indian medicine men sometimes used the rootstocks of this plant, mixed with the bulbs of meadow deathcamas *(Zigadenus venenosus* S. Wats.) and a little tobacco, as smoking material for their "patients." This induced

severe nausea and resulted in a heavy fee to make the sick man well again.

The following two species may be cited as representative of the group of native Pacific States irises:

1. **Foothill iris** ***(Iris hartwegii* Baker)**, known also as Hartweg iris and Sierra iris, is a small California iris, ranging chiefly in foothills of the Coast Mountains and Sierra Nevada—in the latter as far south as Kern County and, in the former, practically the entire length of the State; it also occurs up into the mixed conifer type in the mountains. The species is a frequent associate of deathcamas on dry ridges. The stems are 4 to 12 inches high, the basal leaves equalling or surpassing them. There are usually two flowers; they vary in color from yellow with lavender veins to dark-veined forms with lilac on the border of the "petals" and the inner part yellow; the stout floral tube is *very short* (about ¼ inch long). The species, as do a number of western plants, commemorates Karl Theodor Hartweg (1812–71), a native of Germany and early western botanical explorer and collector.

2. **Tube iris** ***(Iris macrosiphon* Torr.)**, sometimes called "ground iris," is a native of the California coastal ranges. It has a slender rootstock; low slender somewhat flattened stems 1½ to 8 inches high, the basal leaves much surpassing them; linear-lance-shaped, long-tapered bracts, and 1 or 2 bright blue or purplish flowers, the floral tube *very slender and elongated*—1½ to 3¼ inches long. Neither of the above two species appears to have any forage significance; both are in ornamental cultivation.

Blue-Eyedgrass *(Sisyrinchium)*

There are perhaps 16 western range species of this genus, the number depending on one's specific concept (for many segregates have been proposed) and on whether or not are included the yellow-flowered *Oreolirion* group and the monotypic, large-reddish-purplish-flowered *Olsynium* with filaments united at the base only. These plants are relatively small herbs perennial from fibrous roots and a short rhizome; the leaves are linear and 2 edged or 2 winged; the flowers are mostly rather small, regular, blue or bluish except in albino forms and in the *Olsynium* and *Oreolirion* sections, in a small, almost umbel-like cluster subtended by bracts *(spathe)*, the perianth segments ("petals") usually ending in a short point *(apiculate)*, the pistil surrounded by the stamen tube. The fruiting capsules are globular but somewhat bluntly 3 angled, containing small spherical seeds. Most of the species are characteristic of moist meadows and streambanks but occasionally they occur in drier places. Probably in general they are of slight or negligible forage significance, but there appear to be exceptions and further study of the matter is strongly indicated.

The following five briefly annotated species are among the most typical range members of this genus:

1. **Common blue-eyedgrass** ***(Sisyrinchium angustifolium* Mill.,** syns. *S. anceps* Cav., *S. gramineum* Lam.), with narrow leaves drying blackish, and often nearly equaling the stems, the two

bracts of the spathe about the same length, is the most widespread of our native species; it ranges from Newfoundland and Quebec to British Columbia and south to Montana, Colorado, Kansas, Texas, and Florida. As a rule this plant is regarded as negligible from the forage standpoint.

2. **California blue-eyedgrass** ***(Sisyrinchium bellum*** **S. Wats.)**, also known as western blue-eyedgrass and nigger-babies and, by Spanish-speaking people, as "azalea" and "villela," is the common blue-eyedgrass of California and Lower California, growing almost everywhere in moist meadows and grassy hillsides from near sea level to the ponderosa pine type but rare in desert and other dry areas. The stems are about 4 to 20 inches high, noticeably overtopping the leaves, and are marked in this genus because of the possession of one or more nodes, or joints, from each of which proceed from 1 to 4 flower stalks.

The flowers are bluish or violet purple, with a yellow "eye," and the 6 segments (petallike parts) are relatively broad, with 4 to 6 nerves, cut and toothed at the apex. The two spathe bracts are nearly equal in length; the stamen filaments are united to the top, and the fruiting capsules are brownish green. According to present knowledge, the forage value of this plant is unimportant; it is sometimes cultivated as an ornamental, a situation suggested by its scientific name *bellum* (Latin adjective for beautiful). A related species, with the similar habit of branching stems, is **sticky-pod blue-eyedgrass** ***(S. radicatum*** **Bickn.)**. It has elliptical glandular fruits. This species occurs in moist-wet sites from "desert" to mountain types in Wyoming, Utah, Nevada, and northern Arizona.

3. **Douglas blue-eyedgrass [*Sisyrinchium douglasii* A. Dietr.,** syns. *S. grandiflorum* Dougl. (1830) *not* Cav. (1790), *Olsynium douglasii* (A. Dietr.) Bickn.] occurs along streams, in moist meadows, and the like from the big sagebrush to the ponderosa pine and aspen types, from British Columbia to northern California, Nevada, Utah, and Idaho. The plant is 6 to 14 inches high; the stems are somewhat flattened but are not margined or winged; the basal leaves are much reduced and bractlike; the outer bract of the spathe is much elongated and overtops the flowers; the reddish purple (rarely white) flowers, the largest among our native species, appear early (March-April), the segments, or petal like parts up to 20 mm., or 4/5 inch long, the stamen stalks *(filaments)* are united at the base only, the pistil stalk *(style)* much longer than the stamens. The plant is sometimes cultivated as an ornamental; it is generally considered negligible as forage.

4. **Idaho blue-eyedgrass** ***(Sisyrinchium idahoense*** **Bickn.)** (fig. 13) occurs in mostly low-altitude, moist grasslands from southern British Columbia to western Montana, Wyoming, Idaho, and California. It is a fibrous-rooted perennial with slender, unbranched, mostly leafless, winged flowering stems 4 to 16 inches high. The firm basal leaves, about half as long as the stems, are narrow (1 to 3.5 mm. broad). The flowers, on hairless *(glabrous)* stalks vary from pale blue (almost white) to violet purple, with a small yellow eye, the 6 perianth segments ("petals") about 3/8 to 5/8,

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FIGURE 13.—Idaho blue-eyedgrass (*Sisyrinchium idahoense* Bickn.).

occasionally nearly ¾ inch long, ending in a sharp tip *(aristulate)*, the ovary glandular; the 2 spathe bracts dissimilar, green or somewhat purple, often deflexed, often shorter than the flowers, the inner broader and shorter than the 1 to 2½-inch-long outer bract. The species apparently is of no forage significance.

5. **Montana blue-eyedgrass** ***(Sisyrinchium occidentale*** **Bickn.)** occurs from Montana and Idaho to Nevada, Utah, Wyoming, Colorado, and New Mexico; possibly also in North Dakota. The flower segments are one-half inch long or more, deep blue or purplish and rounded at the tip; the fruiting capsules are rounded and smooth. **Alkali blue-eyedgrass** ***(S. halophilum*** **Greene)**, growing in alkaline meadows of the sagebrush and woodland types of Wyoming, Utah, and Nevada, is closely related but the flowers are smaller, paler, the segments sharp tipped and the fruiting capsules fine-hairy *(puberulent)*. The forage value of both species generally appears to be negligible but both have been observed to be limitedly grazed by cattle.

ORCHID FAMILY (ORCHIDACEAE)

This well-known family, represented in the western range area by 16 genera and 70 species, is of little or no forage importance. The family provides many cultivated ornamentals. Despite its immense size, it is of little economic interest. The roots of our native

and widely distributed **small yellow ladyslipper** [***Cypripedium calceolus* var. *parviflorum* (Salisb.) Fern.**, syn. *C. parviflorum* Salisb.] are an official drug used as an antispasmodic. The leaves of **Bourbontea** [***Jumellea fragrans* (Thouars) Schlechter**, syn. *Angraecum fragrans* Thouars], a native orchid of the Mascarene Islands (east of Madagascar), furnish a fragrant, tealike beverage known as Bourbon tea and faham tea, popular in France and elsewhere. Mexico is the chief source of the familiar flavoring extract derived from the "beans" or pods of **vanilla** ***(Vanilla planifolia* Andrews)**. Saleps, used as food and for their starches and gums, are derived from the tubers of European species of *Orchis* and East Indies species of *Eulophia*.

NETTLE FAMILY (URTICACEAE)

So far as the western range is concerned this family consists of three genera and about a dozen species. The only genus of any range significance is *Urtica*. The family is closely related botanically to the elm-hackberry (Ulmaceae), mulberry-fig-Osage-orange (Moraceae), and hemphops (Cannabinaceae) families which were, in fact, included in Urticaceae in the older botanies. Our species are annual or perennial herbs, more or less hispid or hairy (in two genera with stinging hairs); leaves opposite or alternate, simple, toothed or entire, with or without stipules; flowers small, greenish, in loose clusters from the leaf axils or in catkinlike spikes, perfect or one-sexed, the sexes sometimes separated on individual plants; there are no petals; the calyx is 2 to 5 (often 4) lobed, the (often 4) stamens are coiled like a watchspring and, when released, are able to fling the pollen for quite a distance; the fruit is dry (an *achene)*, flattened of ovoid, covered by the persistent calyx, and with a straight embryo. **Ramie** ***(Boehmeria nivea)***, the strongest of all fibers, belongs to this family.

One of the genera, **hesperocnide** ***(Hesperocnide)*** consists of but one Californian species (there is another in Hawaii); it is an opposite-leaved annual with stinging hairs, similar to the genus *Urtica* but with technical floral distinctions, and apparently has no range significance. It is sometimes called by the trite name "western nettle" (a translation of the Greek generic name).

A second genus is **pellitory** ***(Parietaria)***, with three range species. They are small annuals with alternate leaves, no stipules, and no stinging hairs. Probably the best-known species is the Old World **wall pellitory** ***(P. officinalis* L.)**, common on walls and houses, and formerly an official drug plant as a diuretic.

Nettle *(Urtica)*

This genus, with about eight range species, consists of annual or perennial herbs, with opposite leaves of an ovate or lanceolate type, having the borders sharply toothed or cut; stipules present at the base of the leafstalks; flowers 4 parted, the segments of the pistillate (female) flowers have the 2 outer ones usually smaller than the 2 inner ones; the achenes are compressed. Nettles are

generally regarded as pests because of the stinging hairs, which livestock (especially horses) and people tend to avoid.

The Old World **bigsting nettle** ***(Urtica dioica* L.)** and **dog nettle** ***(U. urens* L.)**, which are widely naturalized in this country, are generally thought to be worse than our native species. The skin rash caused by nettles is sometimes referred to as *urticaria*, though that term is more often used by physicians for blotches, wheals, or rash caused by some digestive disturbance or allergy. The reddening, intense burning, swelling and itching due to these plants may remain for only a few minutes or last for hours; the stinging tips of the hairs break off under the skin.

Feldberg *(68)* claims that the irritating properties of *Urtica dioica* are not due to formic acid, as has commonly been reported, but to a combination of *acetycholine* and *histamin* (both of which, incidentally, occur in ergot). Long *(123)* mentions the death of a dog from this species reported in Berliner Tierärztliche Wochenschrift (1909). It is of interest in this connection that, in a letter to me dated March 26, 1958, Dr. William L. Giles, Superintendent of the Delta Branch Experiment Station, Stoneville, Miss., states that "for the past year or two hunters in the Mississippi Delta have been reporting cases of hunting dogs becoming lame and some of them dying as a result of poisoning from the (locally very common) ***Urtica chamaedryoides* Pursh."**

With a few possible exceptions the palatability of nettles to domestic livestock varies from nil to low; deer sometimes crop them a little. Despite their unpopularity, nettles are not without some economic interest. Smith *(183)*, in annotating *Urtica dioica*, says: "Cultivated in France as an early soiling crop for mules and milch cows. The seeds are fed to horses. It grows in arid, sandy, and stony land and in very cold places where few other crops succeed."

Available analyses appear to indicate that nettles are high in protein. For example, Herbage Abstracts for March 1936, in furnishing notes from P. F. Medvedev's paper *The Nettles of the U.S.S.R.: Specific Composition, Distribution and Utilization* (1934) states: "Nettles, particularly annual forms, are superior to lucerne or clover in mineral content, and to lucerne, Sudan grass * * * in protein * * * The plants are therefore excellent fodder and have been so used in northern countries for many years. The presence of vitamins A and C in the green forage renders it valuable ***" Fernald and Kinsey *(70)* refer to the popularity of nettles among country people in Europe, especially Scotland and Ireland, as a potherb and for the former use of the flaxlike fibers for making sheets and tablecloths, for which purpose some considered it more durable than linen. Occasional reports are heard of the use of nettles as a spinach substitute in this country; one must assume the plants are garnered with heavy gloves.

Perhaps the two commonest range species are **narrowleaf nettle** ***(Urtica gracilis* Aiton)** and **Lyall nettle** ***(U. lyalli* S. Wats.)**. Narrowleaf nettle, sometimes called slender nettle, ranges from Newfoundland and the Hudson Bay region to Alaska and south to Cali-

fornia, Arizona, Texas, Louisiana, and North Carolina. It occurs in a variety of sites, waste places (fence rows, old fields, etc.), damp woods, canyons, rich alluvial soils along streams, etc. In the mountains it is found chiefly in the ponderosa pine belt, and is often common locally. In Colorado is occurs between elevations of 4,000 and 9,000 feet. Livestock generally avoid it, and it is commonly regarded as worthless for forage.

Chesnut *(37)* refers to narrowleaf nettle covering thousands of acres of reclaimed swampland in Michigan and Wisconsin, and to the difficulties of cultivation due to its presence. Blankinship *(27)* notes that the Sioux Indians called the root of this plant "shanpi" or "wicaro nakum" and used it "as a remedy for retention of urine" (reminiscent of the fact that the roots of the Old World ***Urtica dioica* L.** and ***U. pilulifera* L.** have diuretic properties, *fide* Lyons). Blankinship continues: "the bark appears to have been used for cordage and the young shoots were employed as a potherb."

Lyall nettle *(Urtica lyallii* S. Wats.), ranging along streams and in bottom lands from Vancouver Island and British Columbia to California, and Idaho, is similar to narrowleaf nettle but with considerably broader leaves. It is named for Dr. David Lyall, surgeon botanist of the U.S. Canadian International Boundary Survey (1858–60). Ordinarily it is regarded as worthless for forage.

BUCKWHEAT FAMILY (POLYGONACEAE)

This is a moderately large, rather widely distributed family, represented in the western range area by about 12 genera and 315 species, of which the greater part, except perhaps for the genus *Eriogonum* (which is particularly well developed in the Rocky Mountain region), occur in California. The bulk of the 36 range species of *Chorizanthe* (low, often prostrate or spreading annual or perennial herbs) occur in California; those species with awned floral involucres are called "spineflower" and two species (**Palmer spineflower, *C. palmeri* S. Wats.**, and **Turkish-rug, *C. staticoides* Benth.**) are occasionally cultivated as ornamentals in warm dry areas. **Common buckwheat *(Fagopyrum esculentum* Moench,** syn. *F. sagittatum* Gilib.) occurs as an occasional escape from cultivation.

Four annuals of monotypic genera are confined to California: **goldcarpet *(Gilmania luteola* Coville,** syn. *Phyllogonum luteolum* Coville), **hollisteria *(Hollisteria lanata* S. Wats.)**, **woollyheads *(Nemacaulis denudata* Nutt.)**, and **pterostegia *(Pterostegia drymarioides* Fisch. & Mey.)**. In addition, there are in California two other introduced annuals: **Spiny emex [*Emex spinosa* (L.) Campd.]** from the Southern Hemisphere, and **lastarriaea *(Lastarriaea chilensis* Remy)** apparently from Chile. None of these annuals is known to have any particular forage significance.

From the range standpoint there are three important genera: *Eriogonum, Polygonum* (including its segregates), and *Rumex*. This importance is due more to the great number of species, wide

distribution, and abundance than to high palatability. In addition to a number of cultivated ornamentals and buckwheat, the family contains the **garden rhubarb** ***(Rheum rhaponticum* L.)** and the medicinal rhubarbs, especially **sorrel rhubarb** ***(R. palmatum* L.)**, the latter also grown as an ornamental foliage plant. Polygonaceae are herbs, vines, shrubs or trees, with mostly alternate (sometimes opposite or whorled) and entire leaves; the stipules usually united into a sheathing tube *(ocreae);* small, 2- to 6-parted flowers, a superior ovary, and a dry indehiscent, 1-celled, 1-seeded fruit *(achene).*

Eriogonum *(Eriogonum)*

Eriogonums form an exclusively North American genus; there are about 175 species in the 11 Far Western States, the Rocky Mountains area being the chief center of distribution, and all but 4 species, outside of the comparatively few Mexican ones, occur between the Pacific Ocean and the Mississippi River. Various local names are applied to these plants, including catsfoot, grouseweed, Indian-tobacco, and wild buckwheat. Growth habit within the genus is variable. The species may be annuals or perennial herbs, undershrubs or shrubs. Most species have taproots; some of the undershrubs have spreading or prostrate stems which tend to root at the joints or near the ends.

The herbaceous eriogonums frequently have but one main stem, which may be either simple or branched and with or without leaves. Those species inclined to be shrubby usually have several stems, but often the flower-bearing parts are herbaceous, erect, and leafless *(scapelike).* The leaves are simple and entire, and in many herbaceous species are basal, but they may also occur alternately or in whorls on the stems. The small individual flowers are jointed to a slender stalk *(pedicel),* with 6 segments in 2 rows, 9 stamens, and 3 styles, and are arranged in umbels, heads, cymes, racemes or other clusters, often compounded, various groups of flowers more or less protruding from a 4- to 8-toothed or lobed involucre. The fruit is a 3-angled or 3-winged achene.

The eriogonums appear at practically all elevations, from sea level to above timberline. However, throughout their range they are primarily plants of essentially dry situations preferring rocky, sandy, and well-drained soils in regions of moderate or low rainfall, and can even withstand long dry summers. Most of them grow in exposed, sunny, and warm sites, even when associated with brush or conifer and other woodland types. The genus is perhaps most abundantly represented in the foothill areas, especially those bordering the deserts of the Intermountain, Southwestern, and California regions.

As a group, the eriogonums are inferior forage plants. Their importance is due to abundance, wide geographic distribution, and great number of species. Their use is limited largely to spring and fall or winter. In the spring the new growth, especially in the herbaceous species, is somewhat succulent, so that livestock tend to crop it, or to nip off the flower heads as they develop. Because of

the absence of more palatable forage during the fall or winter, the somewhat shrubby species are at least slightly grazed. Taken as a whole, the eriogonums, so far as their herbage is concerned, probably average from worthless to poor for cattle, and from poor to fair for sheep. Livestock, however, particularly sheep, are fond of the flowering tops and frequently pick these off and ignore the rest.

The eriogonums seldom form extensive patches or become the dominant vegetation, but are characteristically scattered with greater or less frequency among associated plants; exceptions to this rule include the local concentration of some annual species on depleted areas.

Economic notes for four shrubby eriogonums are given in Important Western Browse Plants *(54)* and the Range Plant Handbook *(204)*. Brief notes on some of the commonest herbaceous species follow.

Wing eriogonum ***(Eriogonum alatum*** **Torr.)** (fig. 14), a rather coarse hairy herb perennial from an elongated thick taproot, ranges from the Panhandle area of Texas, through western Okla-

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FIGURE 14.—Wing eriogonum (*Eriogonum alatum* Torr.) and nodding eriogonum (*E. cernuum* Nutt.).

homa, Kansas, and Nebraska, to southern Wyoming, Utah, and Arizona. The stout erect, usually single stem is 12 to 40 inches high. The leaves are mainly in a basal tuft, of a reverse lance-shaped type with the broader end forward, hairy above, about 1 to 4 inches long, the stalks of old leaves persisting on the root-crown. Greenish yellow flowers appear mainly during July and August in open panicles. The fruits are *3 winged,* relatively large (about ¼ inch long) achenes.

Wing eriogonum occurs scatteringly from sagebrush plains to foothills and, in the mountains, up to the ponderosa pine and Engelmann spruce belts, chiefly in rather dry sandy soils. The plant is seldom touched by cattle; the tops are the part chiefly nibbled; when sufficiently abundant it is considered as a fair species on southwestern goat and sheep ranges. The root was used medicinally by certain Indians *(109, 191).*

There are two annuals of no importance for grazing but worthy of mention because of commonness. (1) **Nodding eriogonum *(Eriogonum cernuum* Nutt.)** (fig. 14) is often plentiful in waste places and in overgrazed areas on plains, foothills, and canyons upward to the spruce belt. It ranges from Alberta and Saskatchewan, to Nebraska, Kansas, New Mexico, California (Colorado desert), and eastern Oregon. This annual grows from 6 to 16 inches high, with a much-branched inflorescence. The small white or pinkish flowers are borne in numerous, characteristically nodding, stalked clusters scattered along the branches of the inflorescence. (2) **Broom eriogonum *(E. vimineum* Dougl.)** has several wiry branching stems, a somewhat broomlike appearance, and is borne rather stiffly erect. The rather few, stalkless, rose-colored, or yellowish flowers are clustered at the ends of the panicle branches. Its range is from eastern Washington and Idaho south to California ,Arizona, and southwestern Utah.

Closely related to the preceding species *(Eriogonum vimineum)* is **sorrel eriogonum *(E. polycladon* Benth.)** a densely white-wooly annual with erect, many-branched stems from about 12 to 20 inches high. Its numerous, bright rose-pink flowers, rather suggestive of sorrel, are borne in slender, one-sided racemes. It occurs in dry, open, sandy, or gravely plains and foothills from western Texas to Arizona and northern Mexico and has a little local utility as a sheep and cattle weed. Bidwell and Wooton *(22)* have published a chemical analysis of this plant. Kearney and Peebles *(109)* mention that in southern Arizona it is "so common at roadsides and in washes as to color the landscape in places with its tall gray stems and pink flowers."

As a vegetable curiosity perhaps another annual (though occasionally it has a longer life span) should also be mentioned here, viz **desert-trumpet *(Eriogonum inflatum* Torr.)**. It ranges from western Colorado (rare), Utah, Nevada, and New Mexico to California, being common along washes and on mesas and deserts. As the Latin specific adjective suggests, the swollen tubular stems, naked except for the basal leaves, are inflated and trumpetlike near their ends. After the terminal, diffusely branched inflores-

cences fall off (often as units) and are blown away, the remaining stems whiten and tend to separate at the joints into pieces, which, when strewn over the ground, have given rise to the names "cigaretteplant" and "Indianpipe weed." The young stems are reported to have been eaten raw by Indians *(215)*.

In Arizona, New Mexico, and southern Utah is another common annual, **wirestem eriogonum** ***(Eriogonum pharnaceoides*** **Torr.)**. This species has whorled linear leaves, wiry fine-hairy stems 4 to 12 inches high, and open whorl-bracted cymes of rose-colored flowers. It occurs chiefly in open woodland types. Despite its small leafage and wiry character, it is cropped a little in summer by sheep and cattle, and is considered to provide "fair" grazing on the Sitgreaves National Forest (Arizona), which is approximately the type locality.

Mat eriogonum ***(Eriogonum caespitosum*** **Nutt.)** is a low, densely matted or cushionlike plant occurring largely on dry mountain slopes and especially in volcanic soils, from Montana and Idaho south to eastern Oregon, California (east of the Sierra Nevada), Nevada, Utah, Colorado, and Wyoming. The leaves are basal, oval or elliptic, white-woolly on both faces. The flowers are yellow, turning purplish or reddish in age, hairy below, several together in hairy or woolly, deeply lobed involucres solitary at the ends of naked stems 1 to 3 inches tall. The plant has practically no forage value, though sheep on summer range may occasionally nip off the skimpy tops; it serves locally as ground cover.

Rush eriogonum ***(Eriogonum elatum*** **Dougl.)** occurs naturally on dry plains and gravely, rocky hillsides from Washington to California, Nevada, and Idaho. It has rushlike, sometimes swollen and almost leafless stems occasionally as high as 3½ or 4 feet, with whitish or pinkish flowers at the ends of the branches; root and crown are woody. The large, long-stalked basal leaves somewhat suggest those of a small arrowleaf balsamroot [*Balsamorhiza sagittata* (Pursh) Nutt.]. The forage value is insignificant.

Yellow eriogonum ***(Eriogonum flavum*** **Nutt.)**, perennial from a dark-colored, thickened woody root, ranges from southwestern British Columbia, Alberta and Saskatchewan to the Black Hills of western South Dakota, western Nebraska and Kansas, Colorado, Utah, the Kaibab Plateau of northern Arizona, Nevada, California, and Oregon. It has been reported from eastern Washington but the record appears doubtful; there is no record of its occurrence in Montana and New Mexico. The silky-hairy stems are mostly 4 to 10 inches high, with thickish crowded spatula-shaped leaves permanently snowy-white-woolly beneath; the flowering umbels have bright yellow, densely pubescent flowers with a short stipelike base.

The plant's usual habitat is rather dry hills, canyons, and mountains up to about 3,000 feet in the north and up to 12,000 feet in the southern part of its range. A full-page illustration of this plant will be found in Stock-Poisoning Plants of Montana *(39)* where it is listed among plants suspected by stockmen of poisoning stock. There is no evidence that any species of this genus is poisonous,

and it seems likely that stockmen mistook it, because of the inflorescence, for some umbellifer, or "poison parsnip."

Very closely related to yellow eriogonum, so closely in fact that some botanists consider it a mere variation [*Eriogonum flavum* var. *piperi* (Greene) M. E. Jones]—is **Piper eriogonum** ***(E. piperi* Greene)**, named for the distinguished American botanist and agronomist Charles Vancouver Piper (1867–1926). Its type locality is in the Blue Mountains of northwestern Oregon where it has become conspicuously abundant on some badly depleted ranges. It occurs on high open sunny sites from Washington and Oregon to western Montana and northwestern Wyoming. Its chief differences from typical *E. flavum* are in a more matted growth and more greenish and larger flowers which are attenuated below into a slender tubular base.

James eriogonum ***(Eriogonum jamesii* Benth.)**, known locally as antelope sage, ground chaparral, and redroot, a somewhat trailing perennial from a woody base, 4 to 12 inches high, occurs on plains and foothills from western and northern Texas to western Kansas, Colorado, Utah, Arizona, and New Mexico. The leaves are thickish, elliptical or spatula shaped, green above, the lower surfaces (like the stems) densely gray- or white-woolly. The flowers are whitish or cream color, with a narrowed stipelike base, arranged in involucres which, in turn, are in irregularly branching cymes. The plant is named for Dr. Edwin James (1797–1861), surgeon-naturalist with the S. H. Long expedition of 1819–20 to the Rocky Mountains, and after whom the Rocky Mountain shrub genus *Edwinia* (syn. *Jamesia* Torr. & Gray, *not* Raf.) is named. Almost negligible as a forage plant.

Barestem eriogonum ***(Eriogonum nudum* Dougl.)** (fig. 15), sometimes called tibinagua, grows scatteringly through dry hills, valley flats, and mountain slopes from Washington to California and Nevada. Davis does not include it in his Flora of Idaho *(50)* but a peculiar form, tentatively referred to this species, has been collected on the old Weiser (now Payette) National Forest, west central Idaho. The species is variable and numerous varieties have been proposed. The smooth and rather slender stems grow up to about 3 feet tall, the basal leaves arising from a short woody crown; the leaves, slender stalked, are densely short-white-woolly beneath but soon become hairless or nearly so on the upper surface. The flowers are usually white but often tinged with rose (or yellowish in some varieties), and are clustered on a repeatedly two- or three-forked inflorescence. The succulent stems are palatable when young, but later in the season livestock rarely display interest in the plant except perhaps to nibble at the flowers.

Cushion eriogonum ***(Eriogonum ovalifolium* Nutt.)**, sometimes called ovalleaf eriogonum or silverplant, ranges from the Kootenay region of southeast British Columbia and Alberta southward to New Mexico, Arizona, and California, especially on exposed, rather rocky sites on plains and slopes from the sagebrush to the lodgepole pine and spruce belts. The flowers typically vary in color from yellowish with green or pink veins to bright yellow turning pur-

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FIGURE 15.—Barestem eriogonum (*Eriogonum nudum* Dougl.); redroot eriogonum (*E. racemosum* Nutt.); and sulfur eriogonum (*E. umbellatum* Torr.).

plish in age; however, some forms have whitish, pink, or wine-red flowers and these color and other differences have been considered by some botanists as deserving varietal or even specific rank. The low cushion of small, crowded, rounded, almost felty leaves from the short, closely branched, woody caudex, and the numerous, rather short and slender scapelike flower stalks with their single, headlike flower clusters, constitute the characteristic growth habit of the species. Although cushion eriogonum is cropped to some

extent by sheep and goats as fairly good winter forage, and on some exposed sites is a valuable ground cover, the stand is often very sparse.

Scragglytop eriogonum ***(Eriogonum proliferum*** **Torr. & Gray)** occurs on river flats and also dry plains and slopes from the sagebrush type, through the pinyon-juniper belt, up to ponderosa pine forest (occasionally higher), from eastern Washington and Idaho south to Nevada and northeastern California. The woolly leafless stems, 6 to 12 inches high, arise from a tufted woody crown; the small, oval to nearly round leaf blades are white-woolly on both faces. The flowers are white, turning purplish in late summer and fall, without a stipelike base, there being several heads in an involucre, the central head sessile, arranged in a very irregular cyme, some of whose branches are much longer than others. Of negligible or slight importance as forage.

Redroot eriogonum ***(Eriogonum racemosum*** **Nutt.)** (fig. 15) grows in canyons and on dry plains and hills from Colorado, through Utah and Nevada, to southeastern California, and, through Arizona and New Mexico, to western Texas. It has white-woolly stems 12 to 30 inches or so high; long-stalked leaves, densely white-woolly beneath, abruptly narrowed or somewhat heart shaped at the base, and crowded on the short branches of the woody crown of a thick reddish taproot. The pink or white flowers, without a stipelike base, are arranged in narrow racemelike cymes or these again with racemelike branches separating in pairs at an angle of about 35° to 45°. Hardly important as forage for domestic livestock but deer on the Kaibab National Forest (northern Arizona) are reported to eat the stalks.

Sulfur eriogonum ***(Eriogonum umbellatum*** **Torr.)** is the typical representative of the section of this genus which perhaps forms the commonest and most abundant group within the genus (fig. 15). It occurs in open dry sites in valleys and on mountain slopes up to subalpine elevations, from southern British Columbia, through Washington and Oregon, to California, and eastward to Colorado, Wyoming, and Montana. Like all members of the *Umbellatae* section it is a perennial herb from a tufted, more or less woody crown and root, with leaves basal or clustered at the ends of the branches, and hairless flowers with a stalked *(stipelike)* and jointed base and arranged in simple or compound parsniplike clusters *(umbels)* usually subtended by a whorl of leaflike bracts. As a rule the plant has little forage value except for the fact that sheep pick off the bright yellow, or sulfur-colored flowers, which appear from June to August. The leaves are densely white-woolly beneath. Pammel *(151, p. 419)*, in referring to the local name of "silverplant" given to this species, mentions the oldtime belief that this plant is an indicator of the presence of silver and gold.

At least five other species of the *Umbellatae* section are sufficiently common to justify mention. As a rule they are not likely to be grazed as long as more palatable plants are present; however, livestock, especially sheep, sometimes evince a fondness for their flower and fruit heads. Three of these species have leaves densely

white-woolly beneath and cream-colored flowers turning purplish or reddish with age:

1. **Northern eriogonum** ***(Eriogonum compositum*** **Dougl.)**, ranging in rather dry often rocky sites from Washington and Idaho to northern California; the oblong-ovate leaves are heart shaped at base, the large flowering umbels compound.

2. **Wyeth eriogonum** ***(Eriogonum heracleoides*** **Nutt.)** (fig. 16), originally collected by Nathaniel J. Wyeth (1802–56), the Boston fur trader and explorer whom the naturalist Thomas Nuttall accompanied on one of his western expeditions. It is sometimes called "Indian-tobacco," has a wide range from British Columbia to Montana, Wyoming, Utah, Nevada, and California (Warner Mountains), a woody base, the pubescence sometimes grayish or tawny, and at least one whorl of leaves on the stems.

3. **Subalpine eriogonum** ***(Eriogonum subalpinum*** **Greene)** occurs on dry mountain slopes almost to timberline, from British Columbia and Alberta south to Colorado, Utah, and Nevada. The leafless stems are 4 to 12 inches high.

Two of the species have rich yellow flowers:

4. **Greene eriogonum** ***(Eriogonum neglectum*** **Greene)**, in Wyoming, Colorado, Utah, and Nevada; it has green, at most only moderately hairy herbage, and simple umbels.

5. **Longray eriogonum [*Eriogonum stellatum* Benth.,** syn. *E. umbellatum* var. *stellatum* (Benth.) M. E. Jones], from Washington and Idaho to Colorado, Utah, and California, with a woody base, leaves densely white-woolly beneath, and compound umbels.

Knotweed *(Polygonum)*

The generic name *Polygonum,* derived from Greek *polu*s (many) + *gonu* (knee), referring to the swollen joints characteristic of many species, is visualized differently by various botanists. The more conservative treatment has been rather generally followed in the more recent manuals and that, for convenience, is adopted here. The following subgenera or sections (treated as distinct genera by some botanists) are kept under *Polygonum:* **Fleeceflower** *(Aconogonum),* **cornbind** *(Bilderdykia,* syn. *Tiniaria),* **bistort** *(Bistorta),* and **ladysthumb** or **smartweed** *(Persicaria).* Under this treatment *Polygonum* consists, so far as the 11 Far Western States are concerned, of about 60 species, viz: *Aconogonum,* 3 species; *Bilderdykia,* 2 species; *Bistorta,* 3 species; *Persicaria,* 17 species; and *Polygonum* proper, 35 species.

These *Polygonum* segregates—all are annual or perennial herbs, though a few are somewhat woody at base—may roughly be distinguished as follows:

Plants vinelike and twining. Flowers in axillary clusters, with 5 calyx parts and 8 stamens; achenes (dry seedlike fruits) 3 angled, brown or black, granular or smooth and shining *Bilderdykia.*

Plants not vinelike and twining.

Leaf blades jointed at base; sheathing stipules *(ocreae)* 2 lobed,

F–77414

FIGURE 16.—Wyeth eriogonum (*Eriogonum heracleoides* Nutt.). Note whorl of leaves in the middle of the detached upper half of stem, at left.

papery, becoming lacerate, or torn at apex; calyx lobes 5 or 6; stamens 3-8, included, at least the inner stamen stalks *(filaments)* dilated; achenes 3 angled . *Polygonum* (restricted).

Leaf blades not jointed at base; *ocreae* not 2 lobed and lacerate (sometimes bristle-fringed in *Persicaria);* stamen stalks *(filaments)* slender, not dilated.

Sheathing stipules *(ocreae)* funnel shaped, oblique, more or less open on side facing leaf. Stems branched, rather coarse; all leaves on stems, lanceolate to ovate, often crisped and fringed; achenes 3 angled. Plants up to 6 feet high, sometimes a little undershrubby . . *Aconogonum.*

Sheathing stipules *(ocreae)* cylindrical, not funnel shaped.

Stem base and rootstock thickened, woody, twisted and often cormlike; *ocreae* obliquely cut at top, more or less open on side facing leaf; leaves mainly basal; flowers in a dense terminal spikelike raceme, 5 parted, white, pink or rose, stamens exserted; achenes 3 angled (rarely lens shaped) . . . . . *Bistorta.*

Stem base and rootstock neither thick woody nor cormlike; roots fibrous, slender stolons or rootstocks often present. *Ocreae* squared at tip *(truncate);* flowers in one or more dense or loose spikelike, erect or drooping racemes, white, green, pink or red, peppery tasting in the "smartweeds" and bland in the "ladysthumbs"; achenes usually lens shaped (occasionally, when styles are 3, 3 angled) *Persicaria.*

This representative group, as here constituted, of the buckwheat family is widely distributed throughout the West and occurs in diverse habitats, ranging from extremely dry to (especially in *Persicaria)* very wet or marshy sites. As a class, these plants abound on poor soils, or on areas where such disturbing influences as overgrazing and trampling have depleted the perennial plant cover. On the range they generally grow in greatest abundance in the vicinity of depleted bedgrounds, saltgrounds, and other severely abused sites. Some species are common weeds in cultivated ground; others appear along roadsides. Although generally ranking as undesirable species, knotweeds often mantle denuded areas with a fairly dense cover, which provides some soil protection.

The majority of knotweeds are hairless, much-branched, erect, or sprawling herbs (a few species somewhat undershrubby), with basal or alternate, chiefly narrow leaves, with more or less tubular stipules *(ocreae),* which sheath the stems at the nodes. The small flowers are borne in clusters in the leaf axils or terminal or bunched near the branch ends in spikes, racemes, or panicles. The flowers lack petals; the outer flower parts *(calyx)* consist of 3 to 8 (often 5) nearly separate, petallike sepals, which are pink, rose, white, or greenish and with pale or brightly colored margins, with 3 to 8 stamens, and 3 (usually 2 in *Persicaria)* styles. The small, seedlike fruits *(achenes)* are 3- (usually 2- in *Persicaria)* angled, brown or black, and surrounded by the persistent calyx.

These species are mainly low in palatability, being practically

worthless as forage for cattle and horses, and only fair for sheep and goats; occasionally, however, they furnish an appreciable amount of sheep forage. Inferior forage quality explains why they are cropped somewhat lightly even on heavily grazed ranges, but as they produce an abundance of seed these plants tend to increase and replace their betters which have succumbed to excessive grazing. Hence, a superfluity of knotweed on a range generally indicates destructive depletion from very severe overgrazing. The achenes ("seeds") are an important source of food for birds and rodents *(136)*.

American bistort [*Polygonum bistortoides* Pursh, syn. *Bistorta bistortoides* (Pursh) Small] (fig. 17), is a perennial herb about 10 to 28 inches high. The plant has a woody twisted rootstock, often with a swollen cormlike crown; an unbranched stem; long-stalked, lance- or linear-oblong, mainly basal leaves; and white to rose-color flowers appearing chiefly in July and August, arranged in a dense terminal spikelike raceme about ½ to 2½ inches long, with eight protruding stamens. It is widely distributed, ranging from Montana to British Columbia and Alaska, and southward to California and New Mexico.

It grows in the mountains in wet meadows, swamps, around seeps, in moist openings in the timber and in high, moist mountain parks. It is most typically a plant of subalpine sites (Hudsonian Zone) but it also occurs in meadows at lower elevations, extending down into the ponderosa pine (Transition Zone). It has been collected at elevations as low as 2,000 feet in Montana and as high as 13,000 feet in Colorado. In many localities it grows only as scattered individuals and does not make up any appreciable part of the plant cover whereas in some restricted meadow and park areas, it occurs in great abundance, occasionally being one of the dominant plants.

American bistort, which is closely related and similar to **European bistort *(Polygonum bistorta* L.,** syn. *Bistorta major* S. F. Gray), is eaten by both cattle and sheep along with the grasses and weeds found in its habitat. The palatability varies in different localities; in some places it is regarded as being worthless as forage while in others it is eaten readily, especially by sheep. On the average, this plant is considered to be low to fair as forage for cattle and fair to fairly good for sheep. Deer and elk eat the foliage and stems to a slight extent.

Viviparous bistort [*Polygonum viviparum* L., syn. *Bistorta vivipara* (L.) S. F. Gray] is widely distributed in alpine or subarctic-arctic moist-wet sites of the Northern Hemisphere; in North America, it is found from Greenland to Alaska, up to the shores of Bering Sea and the Arctic Ocean, and south to the Wallowa Mountains of northeastern Oregon, Idaho, in the Rocky Mountains to New Mexico (the plant is doubtfully in Arizona), and Colorado; farther east, the species occurs in the Black Hills of South Dakota, in northern Minnesota and Michigan, and in New Hampshire.

The plant resembles *Polygonum bistortoides* but usually is somewhat smaller in size, the basal leaves oblong to lance shaped, 1 to 4

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FIGURE 17.—American bistort [*Polygonum bistortoides* Pursh, syn. *Bistorta bistortoides* (Pursh) Small].

inches long; stem leaves lance shaped to linear; the rose-colored or white flowers in a typically slimmer and looser spikelike raceme (1 to 4 inches long) than that of *P. bistortoides;* the fruits (achenes) granular and dull. Presumably as a result of the short growing season the plant usually develops bulblets rather than fruits in the inflorescence, especially in the lower part. The plant

has a very limited palatability for cattle and the forage value is nil to poor. In the Far North natives are fond of the thick rootstock and bulblets, eating them as "we would eat nuts and raisins" *(70)*.

Douglas knotweed ***(Polygonum douglasii*** **Greene)** (fig. 18) is an annual with very slender, *erect* but usually much-branched stems 8 to 20 inches tall bearing alternate, linear or narrowly lanceolate leaves (the uppermost ones reduced to *small bracts)*, and axillary clusters of small, bell-shaped flowers whose sepals have white or rose-colored margins. Its 3-sided, *down-bent* fruits are black and shiny achenes. Douglas knotweed ranges from Ontario, Vermont, and New York to the Yukon and British Columbia, and South to California, Arizona, New Mexico, Texas, and Nebraska. East of the Rocky Mountains its distribution is local and there is some evidence that it is naturalized there. The plant memorializes its discoverer, David Douglas (1799–1834), the famous Scotch botanical explorer of the Northwest.

Douglas knotweed occurs at practically all elevations and in limited amounts in a great variety of sites and vegetal types. It abounds on rocky, sandy, or impoverished soils, especially in waste ground and on sites where trampling, excessive grazing, or other destructive influences have largely destroyed the natural, perennial vegetation. It is often, therefore, a reliable indicator of overgrazing, being one of the primary species in the ruderal-early-weed-stage of plant succession *(177)*.

Due largely to its wide range and diversity of habitats, Douglas knotweed has a long period of flowering and maturing, flowers generally appearing from June to September. Although a small plant, it often produces more herbage than any of its associates and, when abundant and during its green and succulent stage, may have limited importance. The herb, however, is practically worthless as forage for cattle and horses and is only fair feed for sheep, except on severely overgrazed areas, where it dominantly abounds and is moderately cropped by sheep and limitedly by cattle. Under such conditions it furnishes an amount of feed equal to that of all the other annual weeds combined *(178)*. Where proper range conditions obtain, the species would seldom occur in sufficient abundance to be significant. A low-value weedy annual such as this, with shallow root system and strong seed habits, may, however, eventually be efficient in accumulating sufficient organic matter to support more desirable perennial plants.

Botanically close to Douglas knotweed are the two following annuals:

1. **Mountain knotweed [*Polygonum montanum* (Small) Greene,** syns. *P. douglasii* var. *latifolium* (Engelm.) Greene, *P. douglasii* var. *montanum* Small], very similar to *P. douglasii* but with broader (oblong to elliptic or oblong-lanceolate) leaves, the upper bracts more leaflike, and probably a greater tendency to have the stems flower-bearing down to near the base. In high mountains, be-

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FIGURE 18.—Douglas knotweed (*Polygonum douglasii* Greene).

tween about 5,000 and 10,000 feet, Alberta to Washington, California, and New Mexico.

2. **Saguache knotweed (*Polygonum sawatchense* Small)**, originally known from the Saguache Range in Colorado, similar to the preceding but with *erect* fruits and much reduced upper leaves. In dry meadows and on open slopes especially in the ponderosa pine belt, from the Dakotas to Washington, California, and New Mexico. The forage significance of these two species is about the same as that of Douglas knotweed.

Akin to the above are the two following prostrate species, with stems leafy to the tips:

1. **Prostrate knotweed (*Polygonum aviculare* L.)**, sometimes called "doorweed" and "knotgrass." A native of Europe and Asia, now naturalized (possibly native in some areas) almost throughout the North American continent except in extreme arctic parts. A very common weed in cultivated grounds, waste places, roadsides, overgrazed areas, and the like. Occurs between elevations of 4,000 and 8,000 feet in Colorado *(171)*. As a rule this plant is negligible or poor as forage and is often considered an indicator of overgrazing. However, reports are sometimes received indicating that is is "much relished by stock" *(158)* and that it is a valuable forage high in crude protein *(183)*.

2. **Box knotweed** (or shore knotweed) [***Polygonum buxiforme* Small**, syn. *P. aviculare* var. *buxiforme* (Small) Robins.], another matted annual, similar to prostrate knotweed but a little stouter, with blunter, broader, thicker, more bluish, veinier leaves, more conspicious sheaths, and with granular instead of wrinkled and streaked "seeds" *(achenes)*. It occurs from New Brunswick and Ontario to British Columbia and Washington, south in the Rocky Mountain area to Nevada and New Mexico, and east to Texas, Missouri, Illinois, and Virginia. Perhaps it is hardly more than a race of prostrate knotweed and, when more fully worked out, it will be known from practically every State. On the range, it is generally regarded as an "early-weed-stage" plant.

The *Persicaria* section of the *Polygonum* genus is represented in the Far West by about 17 species, many of them aquatic or semiaquatic. The species that have peppery-tasting herbage, especially inflorescences, are known as smartweeds or by such names as "bitetongue," "pepperplant," and "water-pepper;" those of blander taste are commonly called "ladysthumb." One Old World species, naturalized in this country, **princesplume ladysthumb [*Polygonum orientale* L.**, syn. *Persicaria orientalis* (L.) Spach] is commonly cultivated as an ornamental; it has been observed to be grazed by deer in the Allegheny Mountains. The smartweed species are normally unpalatable to domestic livestock.

The ladysthumbs, while unimportant as forage plants, occasionally have some minor value. The four range species, briefly annotated below, are fairly representative of this group:

1. **Water ladysthumb [*Polygonum amphibium* L.**, syn. *Persicaria amphibia* (L.) S. F. Gray], known also as redshanks, tanweed, water persicaria, and water willowweed, is an extremely

variable species; a number of species have been segregated from it, but they seem to run into each other hopelessly. This perennial floats in ponds and lakes and also grows erect on muddy banks and in shallow water; it has an enormous range—in Europe and Asia, and in North America from Quebec to Alaska and south to California, New Mexico, Kentucky, and New Jersey.

In floating forms the stems may attain a length of as much as 20 feet. The leaves are mostly of an elliptical type, 1½ to 4 inches long; the flowers, bright rose colored with 5 exserted stamens and a 2-cleft exserted pistil, are arranged in a dense, usually solitary, spikelike raceme about ½ to 1 inch long. The plant has an astringent but not peppery taste and is seldom regarded as a forage plant. Schneider *(180)* reports that this species has been "used in tanning in the Western States; said to contain 18 per centum of tannin. Used as a substitute for true sarsaparilla."

2. Of the very closely related **bigroot ladysthumb [*Polygonum muhlenbergii* S. Wats.,** syns. *Persicaria muhlenbergii* (S. Wats.) Small, *Polygonum emersum* Britt.], a less strictly aquatic, purely American species, with long rootstocks, more tapered leaves, and longer inflorescence, Smith *(183)* reported "this is well regarded as a forage plant for wet meadows and marshy places * * * Cattle are very fond of it." This statement may reflect unusual local conditions.

3. **Glandular smartweed [*Polygonum omissum* Greene,** syn. *Persicaria omissa* (Greene) Small] is an annual, 1 to 2 feet high, beset with copious stalked glands, the leaves translucently dotted, the fruits black and shining, rounded-ovate but almost flattened on one side. It occurs in wet grounds, sinks, swamps, dried-up pond and lake beds and the like, from the plains to middle elevations in the mountains, from western Kansas to Colorado and New Mexico. Ordinarily it is negligible as forage.

4. **Spotted ladysthumb [*Polygonum persicaria* L.,** syns. *Persicaria maculosa* Rydb., *P. mitis* Gilib., *P. persicaria* (L.) Small] is an annual, native to Europe, now widely naturalized almost throughout Canada and the United States. It has narrow leaves chiefly with a conspicuous dark spot, sheathing stipules *(ocreae)* often *short-fringed,* numerous dense inflorescence, and smooth black shining *lens-shaped* fruits. Occasionally grazed by range sheep in summer but ordinarily negligible as forage.

Pokeweed fleeceflower [*Polygonum phytolaccaefolium* Meissn., syn. *Aconogonum phytolaccaefolium* (Meissn.) Small] (fig. 19), sometimes called "wild buckwheat," ranges from California (the type locality) north to British Columbia and Alaska, Idaho, and extreme western Montana; also in eastern and northern Asia. It is a large, stout, bushy-branched, rather succulent herbaceous perennial producing somewhat grooved stems 1½ to 6 feet tall from a deep, stout, coarse, fleshy, sparsely branched root. The numerous oval leaves are fleshy to thin, somewhat crisped and fringed from 1 to nearly 7 inches long. The greenish or whitish panicles are both terminal and axillary, the small greenish-white flowers 5 parted. The fruit is a 3-angled achene.

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FIGURE 19.—Pokeweed fleeceflower [*Polygonum phytolaccaefolium* Meissn., syn. *Aconogonum phytolaccaefolium* (Meissn.) Small].

Its typical habitat is in the subalpine to alpine zones in medium moist, acid soils. Among the first high-range plants to start growth, it flowers from July to September and matures from August to October. Sheep consume the flower clusters, tender shoots, and leaves, which are usually produced in abundance by July 15, as long as they are green and succulent. The fruits are both relished and nutritious. Because of its large size and numerous leaves, the species produces an unusually large amount of forage per plant and therefore holds an important place on many ranges.

Sampson *(176)* states that this plant withstands trampling remarkably well, and is promising for the revegetation of depleted ranges under a system of deferred grazing, having reproduced successfully in many places where natural revegetation experiments have been conducted.

Closely related to the above are the two following perennial herbs, with thickened woody roots, decumbent or erect stems, inflorescences in 2- to 4-flowered axillary clusters, and providing poor to fair sheep feed:

1. **Davis knotweed [*Polygonum davisiae* Brewer,** syn. *Aconogonum davisiae* (Brewer) Heller][13] occurs on rocky slopes of high mountains from Oregon to California; branching, about a foot high, with stout reddish or purplish stems; leaves numerous, lance shaped to narrowly oval, 1 to 2 inches long.

2. **Newberry knotweed *(Polygonum newberryi* Small)**[14] ranges from Washington and Oregon to Mt. Shasta, northern California, typical of dry rocky pumice or lava soil at alpine or subalpine elevations. For years it was confused with the preceding species but the herbage is dull green and more or less pubescent-scurfy (not bluish, glabrous, smooth or roughish or inconspicuously pubescent as in *P. davisiae);* larger and broader, ovate and more distinctly petioled leaves, the flowers *(calyx)* 5 parted to near the base, instead of 5 cleft to the middle, and the fruits have the broader end uppermost instead of the reverse.

Merriam *(140)* mentioned its occurrence on Mt. Shasta as "Abundant from the lower edge of the Hudsonian Zone up to a little above timberline, where its big green leaves are very conspicuous on the pale pumice soil and among the broken fragments of gray lava rock. About the middle of September the leaves turn red—often a deep handsome red—and begin to fall, so that by the end of the month the plant has practically disappeared. Its buckwheatlike fruit is a favorite food of the mice inhabiting the higher slopes." An observer on the Deschutes National Forest (Oregon)

[13]Named for its discoverer and first collector, Nancy Jane Davis (1833–1921), a founder and for 60 years principal of a school in Birmingham, Pa. Miss Davis made important plant collections in California in 1863, 1893, and 1915.

[14]The plant's name commemorates Dr. John Strong Newberry (1822–93), surgeon-naturalist of the Lts. Williamson, Abbott, and Ives' expeditions to the Far West (1855–58), and who was distinguished as a botanist, geologist, and paleontologist.

reported the forage value of the species as "low; eaten to a very limited extend by sheep."

Dock *(Rumex)*

Docks are annual or perennial, often large and coarse herbs, mostly with thickened taproots. The alternate leaves have sheathing stipules and are mostly elongated. The small, greenish or reddish flowers, massed in small whorls, are crowded into compound, often elongated inflorescences; they have 6 sepals in 2 series, the veiny outer 3 unchanged in fruit but persistent at the base of the 3 inner and enlarging ones which eventually clothe the 3-angled fruits *(achenes)*. Male and female flowers usually occur on separate plants. About 28 species of *Rumex* occur in the western range country. The genus is taxonomically difficult and mature fruits are sometimes necessary to be sure of the species.

Sheep sorrel *(Rumex acetosella* L.), naturalized from the Old World, is now established in Alaska and virtually throughout Canada and the United States, in waste places, overgrazed areas, old fields, cultivated ground, etc., often as a troublesome weed. It is perennial from slender running rootstocks, the stems 6 to 12 inches high, the long-stalked leaves eared at the base. The inflorescence is branched or simple, slender and spikelike, often reddish or purplish. The foliage is highly acid; the forage value varies from worthless to fair, the palatability is usually highest in early spring and for sheep.

Closely related to sheep sorrel, and of about equal palatability, is **mountain sorrel *(Rumex paucifolius* Nutt.)**. It grows in mountain meadows and parks from British Columbia and Alberta to California, Colorado, and Montana. The leaves are without earlike basal lobes.

Curly dock *(Rumex crispus* L.), native to Europe and Asia, is naturalized over the greater part of Canada and the United States. It is a smooth, dark green herb, 12 to 40 inches tall, from a thick yellowish taproot, which is an official drug containing chrysophanic acid, or rumicin, used medicinally as a purgative, laxative, stomachic, and tonic. The leaves, up to 12 inches or so long, are oblong or lanceolate, with wavy (crisped) margins; they are often locally used as a potherb. The forage value varies from worthless to fair or fairly good for sheep and cattle.

Canaigre *(Rumex hymenosepalus* Torr.) ranges in dry, often sandy sites up to about 6,000 feet, from Wyoming to Utah, California, Arizona, New Mexico, western Texas and Oklahoma, and south into northern Mexico. It is a smooth erect perennial from a cluster of tuberous roots, the stems up to 40 inches high, the rather fleshy and thick leaves of an elliptic or reverse lance-shaped type, about 2 to 8 inches long. The 3 inner floral parts *(sepals)* are about ½ inch long in fruit, heart shaped at base and more or less reddish. The forage value is mostly negligible. It is conspicuous in the Southwest in winter and early spring, commencing to grow in January or February and blooming in March. Its tubers are used locally for tanning skins, and a small tanning industry that used

this plant was once established at Deming, N. Mex. *(214)*. Analyses of the dried roots have shown tannin content up to as high as 45.8 percent *(95)*.

Mexican dock ***(Rumex mexicanus* Meissn.)** is a plant of wide range occurring from Labrador and Newfoundland to Pennsylvania, Kentucky and Missouri, west to British Columbia, California, Nevada, Arizona, New Mexico and Texas, and south into Mexico. It is a coarse, smooth, pale-green, short-lived perennial herb with a thickened, woody taproot and tufted, simple or branched stems from 1 to 3 feet high, bearing lance-shaped, untoothed alternate leaves. The flowers are numerous, greenish colored, borne on short stems in ascending, almost spikelike clusters. Each of the three inner tubercled sepals has a triangular-rounded wing that is delicately but distinctively veined.

It inhabits dry and rocky to moist and rich soils throughout a wide range of elevations; it is alkali-tolerant and is a common dock along ditches and streams and in cultivated fields. Flowers appear from May to September. Livestock sometimes take Mexican dock to a moderate degree along with other weeds and grasses. Sheep as a rule relish it more than cattle and, since it is a comparatively large plant, it may constitute sufficient of the stand to be of appreciable importance. Sampson *(177)* places the plant among the secondary species of the second-weed-stage of plant succession.

Willow dock ***(Rumex salicifolius* Weinm.)** is similar to Mexican dock and is often confused with it in the books. It perhaps should be considered as confined to the coastal region from Vancouver Island to southern California. It has narrow, somewhat willowlike leaves.

Western dock ***(Rumex occidentalis* S. Wats.)** is a large, coarse perennial herb up to 6 feet high, ranging from Labrador and Quebec to Alaska, California (as far south as San Francisco Bay), Arizona, New Mexico, and Texas; also in Minnesota and Maine. The leaves are of a lance-shaped or ovate-lance-shaped type, up to 16 inches long, heart shaped at base. The flowers and fruit are in a dense panicle up to 2 feet long; the stalks *(pedicels)* are not jointed to the fruits. It is essentially a bog or wet-site plant and has been collected as high as 11,000 feet on the Medicine Bow National Forest, Wyo. Of negligible or limited value as forage, occasionally nibbled by cattle and sheep.

Veiny dock ***(Rumex venosus* Pursh)** ranges, mostly in sandy soils and between elevations of about 4,000 and 8,000 feet, from Washington to Manitoba and south to South Dakota, Kansas, Missouri, Texas, Utah, Nevada, and northeastern California. The ovate or oblong, fleshy and somewhat bluish leaves are up to 5 inches long; the erect stem is 6 to 16 inches high, erect or somewhat bent at base, from a thick, woody taproot. The three inner floral parts *(sepals)* are conspicuously net veined and the fruiting wings are often more than an inch wide. It is sometimes fair sheep feed.

Closely related to the true docks is the arctic or high-montane, rocky-site **alpine mountainsorrel [*Oxyria digyna* (L.) Hill,** syn. *O.*

reniformis Hook.] but differing botanically in having 4 (instead of 6) sepals; 2 (instead of 3) styles, and lens-shaped (instead of triangular) fruits *(achenes)* with 2 broad wings. It occurs in Europe and Asia and, in North America, from Greenland and Labrador to Alaska, south in the East to the White Mountains of New Hampshire and, in the West, to California and New Mexico. It is perennial, 2 to 12 inches high from a woody or leathery taproot, the crown often branched. The leaves are rather few, basal or 1 or 2 on the stems, rounded kidney shaped, and have an acid, sorrel-like taste. The small, reddish or greenish flowers are in narrow racemes or in a raceme-branched panicle. Not important as a forage plant but desirable as a preventive of scurvy in the Far North; extensively used by Lapps, Eskimos, and other arctic people as a salad plant or potherb; whence the local name "scurvy-grass."

GOOSEFOOT FAMILY (CHENOPODIACEAE)

Aside from the more or less woody genera **pickleweed** ***(Allenrolfea)***, **saltbush** ***(Atriplex)***, **winterfat** ***(Eurotia)***, **hopsage** ***(Grayia)***, **greasewood** ***(Sarcobatus)***, and **zuckia** ***(Zuckia)***, which with the exception of the last are annotated in Important Western Range Plants *(54)* and the Range Plant Handbook *(204)*, and for three limitedly naturalized herbs apparently of no appreciable range forage significance—**common beet** ***(Beta vulgaris* L.)**, **flatweed Perubalm** **[*Roubieva multifida* (L.) Moq.]**, and the garden **spinach** ***(Spinacia oleracea* L.)**—the western range flora of this family consists of 14 genera and about 70 species.

Chenopodiaceae are annual or perennal herbs or shrubs—a few Old World species, small trees. The leaves are alternate (except in *Nitrophila* and *Salicornia*, and occasionally in *Kochia* and *Sarcobatus)*, sometimes reduced to scales, often scurfy, mealy, or fleshy. The flowers are petalless, small and homely, often greenish, the persistent calyx 2- to 5-lobed or parted. The small dry indehiscent fruit (sometimes described as a "nutlet," sometimes as a "utricle") has an embryo ring shaped, half ring shaped, folded, or spiral. As a group, the family is notably salt and alkali tolerant.

Gilbert and colleagues *(79)* call attention to the fact that under some circumstances certain weeds such as species of *Chenopodium*, *Kochia*, and *Salsola*, may cause livestock poisoning or losses because of excessive accumulation of potassium nitrate (KNO_3), a common form of "saltpeter." This is particularly likely to occur in limy-shale soils and shade; the nitrate content tends to decrease with plant maturity.

Aphanisma *(Aphanisma)*

Aphanisma ***(Aphanisma blitoides* Nutt.)** is a smooth fleshy annual, up to 28 inches tall, with small stalkless untoothed leaves having clasping bases; small mostly 3-lobed flowers with 1 stamen, and lens-shaped wrinkled seeds. It occurs on or near the sea from southern California to northern Lower California and on the offshore islands. The forage value is questionable.

Goosefoot *(Chenopodium)*

With about 33 range species, *Chenopodium* is the largest range genus in this family. The generic name *Chenopodium* derives from Greek *chen* (goose) + *pous, podos* (foot), alluding to the shape of the leaves of the type species, *C. album* L. Goosefoots are usually white-mealy, often annual herbs, with small greenish flowers mostly clustered in spikelike branches of panicles; calyx mostly 5 lobed, later more or less enveloping the fruit but not developing spines or wings; stamens mostly 5; styles mostly 2; seed lens shaped, with a coiled embryo.

Good King Henry ***(Chenopodium bonus-henricus* L.)**, a European perennial, is sometimes grown as a potherb; **Jerusalem-oak goosefoot,** or "feather geranium" ***(C. botrys* L.)**, an Old World annual, is cultivated chiefly because of its aromatic properties; the tropical American **wormseed goosefoot,** or "Mexican-tea [***C. ambrosioides* L.**, including the doubtfully distinct drug form, var. *anthelminticum* (L.) A Gray], is an important vermifuge. **Quinoa** ***(C. quinoa* Willd.)** "is a staple good of millions of South American natives" *(96),* the highly nutritious seeds being used; quinoa is limitedly grown in this country as a potherb.

The five species annotated below are reasonably representative of the genus as it occurs on the western range:

1. **Lambsquarters goosefoot** ***(Chenopodium album* L.)** (fig. 20), often called "pigweed" and "white goosefoot," is native to Europe and Asia but is now naturalized and a common weed practically throughout the United States, as well as Canada (except the actually arctic parts) and has become established in Alaska. It is a pale annual herb with a usually erect, grooved, much-branched stem, up to 9 feet high, bearing numerous ovate, rhombic, or spear-shaped leaves which are rounded or wedgelike at base, often sharply or wavy-toothed, more or less white-mealy on both sides and paler below. Small, greenish flowers in clustered spikes are produced at the apex of the stem and in the axils of the leaves. The black shiny seeds are borne horizontally, the outer coat *(pericarp)* of the fruit closely adherent to the seed, the embryo a complete ring.

The plant is of most frequent occurrence at lower and medium elevations, in fields, along roadsides and in waste places. It varies from poor to good sheep feed and, as a rule, is grazed to some extent by cattle. Undoubtedly it has some value to livestock generally throughout its range, although not one of the more important forage species. The young plants are, in many places, used as a potherb. Blankenship *(27)* reports that some Montana Indians grind the seeds into flour for use in making bread. Sampson *(177)* reports it as one of the six most typical and abundant plants in the first weed stage of plant succession in the Wasatch Mountains area of Utah.

2. Related to lambsquarters goosefoot but smaller and darker is **dark goosefoot** ***(Chenopodium atrovirens* Rydb.)**, which occurs on plains and foothill slopes from Montana and Idaho to Nevada, Utah,

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FIGURE 20.—Lambsquarters goosefoot (*Chenopodium album* L.).

and Colorado. It has been attributed also to eastern Oregon, California, and New Mexico but this has occasioned controversy. The plant is an erect annual, 20 inches high or less, simple or branched; the small (under 1.2 inches) oblong to ovate leaves are rounded to wedgelike at base; the flowers in short dense spikes. It is of little value for sheep.

3. **Fremont goosefoot** ***(Chenopodium fremontii S. Wats.)***, named for its discoverer, "The Pathfinder," Gen. John Charles Frémont (1813–90), ranges from North Dakota to central British Columbia, Washington and Oregon (east of the Cascades), California, northern Mexico, and western Texas. It is an annual, more green than mealy, up to 30 inches or so high, with ovate-lance-shaped to triangular-hastate, thin, often long-pointed leaves; the leafstalks are at least half as long as the blades. The shiny black seeds are borne horizontally, the outer fruit covering *(pericarp)* separating freely from the seed. The plant ranks among the better goosefoots in point of palatability. Griffiths *(85)* and Kearney and Peebles *(109)* mention that it is often abundant and produces a considerable amount of feed for both cattle and sheep on fall range in Arizona.

4. **Raggedleaf goosefoot** [***Chenopodium incisum*** **Poir.,** syns. *Teloxys cornuta* Torr., *C. cornutum* (Torr.) Benth. & Hook.] ranges from southern Colorado and eastern Utah to Arizona, New Mexico, and south into Mexico, occupying dry, often rocky places, plains and foothills up to the woodland and lower ponderosa pine belt, sometimes common in good soils; often grows thickly under juniper and pinyon trees between elevations of about 4,000 and 7,500 feet. The plant is a glandular, sweet-scented, erect, branched, often reddish herb 8 to 20 inches high. The pinnately lobed leaves are ¾ to nearly 2 inches long, the lobes lance shaped to oblong and untoothed. The flowers are very minute in cymes from the leaf axils; the seeds are only about 1/50 of an inch broad, bluntly margined, their embryos horseshoe shaped.

This plant has been observed to be moderately grazed by cattle and horses on the Santa Fe National Forest (New Mexico). Stevenson *(191)* states that the Zuni Indians call the species *hatechi*, meaning "strong-odor-leaf," and, after steeping it in water, inhale the vapor as a headache remedy. Because of its fall coloration the plant is sometimes called "bloodweed."

5. **Slimleaf goosefoot** ***(Chenopodium leptophyllum Nutt.)*** is rather closely related to the common *C. album*. Its natural range is dry plains and foothills from Manitoba and Alberta to eastern Washington and south to California and western Texas. However, it is an aggressive species and has become naturalized in the Eastern States and Europe. It has thickish, linear to narrowly oblong leaves, short leafstalks less than a quarter as long as the blades, and the outer fruit covering *(pericarp)* is free from the seed. Negligible to fair as a sheep and cattle weed.

Closely related to the goosefoots, and by some botanists generically merged with them, are the three range species of **blite** ***(Blitum)*** (fig. 21), at least one of which is in every Western State. They are smooth fleshy annuals with flowers clustered in roundish heads which sometimes form an interrupted spike; the flowers (petalless calyces) become succulent and bright red in fruit, which has suggested one of the common names, "strawberry blite." Sheep relish blites in some sections which they scarcely touch them in others, and cattle often consume a considerable part of these plants

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FIGURE 21.—Strawberry blite, or blite goosefoot [*Blitum capitatum* L., syn. *Chenopodium capitatum* (L.) Aschers.]. Fruiting head and detached utricle, or "seed" at lower right.

along with other more relished species. Due to scattered distribution and only slight to medium palatability, the species do not rank high as range feed.

Tickseed, or bugseed ***(Corispermum)*** is a genus, so far as the western range is concerned, of about 4 closely related species or, according to some botanists, 3 or 4 are American races, forms or varieties of the Old World **hyssopleaf tickseed (*C. hyssopifolium* L.)**, now rather widely naturalized (or perhaps native) in many parts of this country. These are annual herbs, with stalkless untoothed leaves, the flowers consisting of very small 1- to 3-lobed calyces arranged in spikes, the stamens 1 to 5, and the stigmas 2. The fruit is a small, dry, flattened, rounded to elliptical *utricle,* with a sharp or narrow-winged margin, and strikingly suggestive of a tick or "bug"—whence the scientific generic name (from Greek κορϊς, bedbug, + σπέρμα, seed).

Shiny tickseed *(Corispermum nitidum* Kit.) differs little from *C. hyssopifolium* except in its much smaller shiny fruits or "seeds." It is a pale green, wiry, bushy annual, widely naturalized in this country from Europe and is a "tumbleweed." It is reported as fair or fairly good cattle feed on the Jornada Experimental Range in southwestern New Mexico, when dried in the fall after first being matured and dampened by summer rains.

Tumble ringwing [*Cycloloma atriplicifolium* (Spreng.) Coult.] is, perhaps with the exception of Russian-thistle, the most characteristic tumbleweed of the West. In the fall the plant breaks off at the surface of the ground and the large, ball-like, aerial part is blown about by the wind, often being carried great distances. In this manner the seeds are disseminated over wide areas. In many places, great walls of the plant may be seen where wire fences or other similar obstructions have collected many individual plants.

Tumble ringwing is the only member of its genus, a bushy-branched, pale green, annual herb, 6 to 20 inches high, becoming dark purple with age, having lance-shaped or oblong, sharp-pointed, wavy-toothed leaves and numerous, loosely flowered spikes, the flowers with 5 stamens, and a 5-lobed calyx. The small flattened-rounded fruits are partially covered by the persistent infolded lobes of the calyx and have a thin rounded wing below (whence the generic name, from Greek κύκλος, circle + λωμα, border) which assists in dissemination.

The species range, which has evidently increased in recent times, includes the area from Manitoba to Ontario, Indiana, Illinois, Kansas, Nebraska, New Mexico, Arizona, Nevada, and southern California. It is very common in fields, along roadsides and streambanks, on sandhills, and in waste places. So far as known the plant is of no value whatever as forage, it is generally considered a more or less pestiferous weed.

Hyssopleaf fivehook, or "smotherweed" **[*Enchinopsilon hyssopifolium* (Pall.) Moq.,** syn. *Bassia hyssopifolia* (Pall.) Kuntze] is a prostrate or erect annual, more or less hairy throughout, with branching stems 12 to 20 inches long; narrowly linear-lance-shaped leaves up to 1½ inches long; small flowers consisting of

a 5-lobed calyx, each lobe bearing a hooked spine (enabling the fruit to catch on clothing, animal hair and wool, and the like), the flowers arranged in small clusters in the leaf axils, the fruit enclosed in the persistent and thickened calyx, with a small horizontal, lens-shaped seed.

The plant is adventive from Europe and the Caspian Sea area and apparently extending its range here. It is now well established in alkaline soils from eastern Washington to eastern California and east into Nevada and Arizona; it is also established in places along the Atlantic coast. Some botanists prefer to retain it in the genus *Bassia*. This plant is ordinarily regarded as a mere weed but may have a little value as ground cover. As a range forage plant it is generally considered negligible; however, more data are desired.

Kennedy *(113)* reports that analyses show this annual herb to be higher in protein than alfalfa and far higher in ash, about the same in ether extract, lower in fiber, and much lower in nitrogen-free extract. He adds that the stems get hard after flowering and that it must be grazed early. Kearney and Peebles *(109)* cite L. L. Stitt to the effect that a leaf bug (*Lygus* sp.), which causes great damage to crop plants, has this plant as its late-summer host.

An Asiastic plant unknown in this country until 1934 is **Halogeton glomeratus** (M. Bieb.) C. A. Mey. (fig. 22), which might appropriately be called Aral barilla, but is universally referred to in this country by the Anglicized generic title **halogeton.** It is a fleshy annual, with small, somewhat fingerlike leaves ending in a sharp point; flowers without corolla, 5 sepals, or calyx lobes; 5 stamens, and vertically borne seeds in a small flattened snaillike fruit *(utricle)* subtended by the persistent and now winged sepals.

Gerald M. Kerr of the Bureau of Land Management, Department of the Interior, writes that "Halogeton produces what are commonly called black seed and brown seed. The black type consists of a dark achene which is loosely held and in most cases will ultimately separate from the bracts. This is the type shown in figure 22 and labeled as having a persistent calyx. The calyx of flowers producing black seed are, however, quite deciduous. The brown seed or fruit is composed of a light brown achene tightly enclosed by sepal bracts which are much more indurate and only slightly winged, if at all. Commonly, these seed types occur together at the plant nodes with a black seed being positioned on each side of a brown one."

This noxious plant is now widely distributed in the lower range "desert" areas of the West and has become a serious sheep poisoning plant in the Inter mountain West. A historical sketch and bibliography will be found in *(55)*. Since that publication (Nov. 1951), three of the more important articles on halogeton are by Bohmont *(29)*, Tisdale and Zappetini *(203)*, and by Cook and Stoddart *(43)*. It is to be hoped that none of the 11 known congeners of *Halogeton glomeratus* will become naturalized in this country.

Kochia *(Kochia)* is a genus of annual or perennial herbs or undershrubby with a woody root and crown. The alternate or

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FIGURE 22.—Halogeton (*Halogeton glomeratus*): *A*, Plant in late flower and early fruit, "brown seed" fairly mature, "black seed" undeveloped; *B*, foliage; *C*, leaf; *D*, fruit clusters; *E*, fruits and scales; *F*, individual fruit with persistent calyx; *G*, scale subtending fruit.

occasionally opposite leaves are narrow and untoothed *(entire)*; the flowers are stalkless, single or clustered in the axils of bracts and consist of a very small rounded 5-lobed calyx, the lobes incurved and producing in fruit a thin horizontal wing on the basal part of each; the 5 stamens are protruded. This essentially Old

World genus is represented in the western range area by about four species, often occurring in alkaline sites. It is named in honor of W. D. J. Koch (1771–1849), a German botanist who was director of the Erlangen Botanical Garden.

Greenmolly kochia (*Kochia americana* S. Wats.), also known as green molly, greenmolly summercypress, and redsage, is an undershrubby plant, 4 to 16 inches high, at first silky-pubescent, (at least often) becoming smooth in age. It ranges from Wyoming to northern New Mexico and westward to California and Oregon. Nelson *(145)* reports that this plant forms part of the spring forage in the Red Desert of Wyoming, when the tender annual shoots are eaten by livestock, the younger twigs being cropped to some extent during the winter months also. In dry saline areas of the Great Basin and Southwest the plant is sometimes fairly important winter sheep feed *(22, 54, 85)*.

Similar in forage significance to *Kochia americana* are the next two (and very closely related) species:

1. **California kochia [*Kochia Californica* S. Wats.**, syn. *K. americana* var. *californica* (S. Wats.) M. E. Jones], also known as California summercypress and Mohave redsage, is found in alkali desert sites, mostly within the creosotebush belt, in southern Nevada and adjacent eastern California, particularly the Mohave Desert. It is hardly more than a form of *K. americana,* differing in having the stems much-branched (instead of mostly simple) and the leaves flat (instead of nearly cylindrical) and broader (1 to 3 mm., instead of about 1 mm. wide).

2. **Gray kochia [*Kochia vestita* (S. Wats.) Rydb.**, syn. *K. americana* var. *vestita* S. Wats.], also known as hairy kochia, gray molly, and gray summercypress, is found on alkaline flats from eastern Oregon to California and west to Colorado and Wyoming. It also is hardly more than a form of *K. americana,* differing chiefly in being permanently pubescent or hairy.

Summercypress, or belvedere **[*Kochia scoparia* (L.) Schrad.]**, a European bushy annual up to 5 feet high, is often grown as an ornamental because of its cypresslike habit and because the common cultivated form of it turns crimson or purple in the summer and fall. This has escaped from cultivation and is widely naturalized practically throughout the United States, chiefly in waste and arid places. Little is known as to the value (if any) of this plant as forage but it probably is negligible or minor.

Nuttall monolepis [*Monolepis nuttalliana* (Schult.) Greene] is a low, somewhat succulent, more or less spreading, smooth (or somewhat mealy when young) annual about 4 to 8 inches high with alternate, lance-shaped, 3-lobed leaves about ½ to 2 inches long, commonly with a large tooth on each side about the middle of the blade. The small often reddish flowers are clustered in the leaf axils and are characterized by being reduced to 1 scale or calyx lobe, 1(or no) stamen, and 2 styles. The small fruits are flattened, the embryo a nearly complete ring. It occurs in moist alkaline or dry soils from Minnesota to Manitoba, Alberta, British Columbia and Alaska and south to California, Arizona, New Mexico, Texas,

and Missouri. It has been reported also from Sonora, Patagonia, and Siberia.

Occasionally, as in cultivated ground where it may be an objectionable weed, this plant grows in sufficient abundance to form an almost continuous layer or mat. Particularly in the southern part of its range, especially the Southwest where it is called "patota" by Spanish-speaking people, it is good sheep forage. Thornber *(201)* reports that, where abundant in valleys and extensive mesa depressions, it is invariably closely grazed. Griffiths *(85)* considered it also as good feed for cattle in Arizona. Used as greens and pinole by Arizona Indians *(109)*.

There are two other less common and less widely distributed native species of *Monolepis*. The generic name (from Greek μονος, solitary, + λεπις, scale) refers to the flower's solitary sepal. The species honors Thomas Nuttall (1786–1859), the well-known English-American botanist, ornothologist, and explorer.

Niterwort [*Nitrophila occidentalis* (Nutt.) S. Wats.] is distributed from about the middle of eastern Oregon south into California east of the Sierra Nevada and along the borders of western Nevada, also in the lower Sacramento Valley and common in the San Joaquin Valley. It is a mostly low, smooth, oppositely branched herb perennial from a sort of taproot or running rootstock which is according to Jepson *(105)* "about the size of a pencil, penetrating vertically (and often maintaining a uniform size) to a depth of 2 feet or more."

The angled and jointed stems, usually more or less decumbent at the base and then ascending, bushy branched, are 3 to 8 or occasionally as much as 16 inches high. Unusual in this family, the leaves are opposite, somewhat fleshy, the lowest ones broadly ovate or oblong, up to ¼ inch long, somewhat persistent and becoming dry and scalelike; upper leaves linear, ½ to 1 inch long. The small flowers are usually 5 lobed, in the axils of small (usually 2) bracts. The small fruits are rounded and brownish, the seeds small, black, and shining.

The plant occurs in moist, often black alkaline soils and near hot springs, sometimes locally abundant and often associated with such alkali-tolerant grasses as saltgrass *(Distichlis)*, alkali muhly *(Muhlenbergia asperifolia)*, and alkali cordgrass *(Spartina gracilis)*. This plant is the only known member of its genus; it has a marked salty taste, and little is known as regards its forage value (if any).

Glasswort *(Salicornia)* is a genus of succulent, usually branched annuals and perennials, with opposite leaves reduced to small scales, the uppermost crowded into a terminal spike; the herbage often turns reddish or purplish. The small flowers are in threes, sunk deeply in axillary pits. The genus is represented by about seven species in the Far Western States, and its members rank among the most salt- and alkali-tolerant of all plants. **Rocky Mountain glasswort (*S. rubra* A. Nels.)**, an annual (considered by some indistinguishable from the Old World *S. europaea L.)*, and the perennial **Utah glasswort (*S. utahensis* Tidestr.)** are typically the nearest plants to the vegetationless shores of the Great Salt

Lake. The plants have a very strong and bitter saline taste and are usually not grazed. Unfortunately glassworts are often called "samphire," a name which should be reserved for the Old World fleshy maritime umbellifer *Crithmum maritimum* L., whose leaves are used as pickles.

Russian-thistle (***Salsola kali* var. *tenuifolia* Tausch,** syn. *S. pestifer* A. Nels.) (fig. 23), one of the numerous annuals known as "tumbleweed," a native of Eurasia, was a serious pest in the Russian wheat fields many years before it spread to the United States. It was probably introduced into Bon Homme County, S. Dak., in 1886 as an impurity in flaxseed imported from Europe *(58)*. The few plants produced increased slowly and almost unnoticed for several years, but after becoming acclimated spread rapidly, and now this weed is widely distributed, especially in more arid parts, over the United States and Canada *(204)*.

Russian-thistle is a bushy-branched annual often 3 or 4 feet high and 2 to 6 feet broad, which is, at first, soft and succulent but becomes rigid with maturity. There are many sessile, slender, threadlike, mostly alternate leaves that become prickle tipped. Flowers are small, papery, and inconspicuous, growing singly or several together in the axils of the spiny leaf clusters, each flower composed of five sepals which, when in fruit, each have a broad, thin, veiny, reddish, horizontal wing. After the plant flowers the leaves wither and fall off and are replaced by short, stout spines in clusters of three; the plant then increases rapidly in size and sends out hard stiff branches. Often the leaves and outer branches become bright red in late summer and fall. Later still, the plant breaks off and becomes a tumbleweed.

Russian-thistle grows from sea level up to 8,500 feet, doing best on high, dry land if not overly crowded by other plants. It does not ordinarily occur in sloughs or lowlands, and makes no progress on the native prairie, except where the sod has been broken by cultivation, overgrazing, prairie-dog holes, etc. This plant flourishes also in rich, moist soils, but does not commonly occur there because of competition from other plants. It is salt resistant and hence grows well, though not exclusively, on alkali soils. It often forms pure stands on cultivated or overgrazed areas.

On early spring ranges this species rates as fair forage for all kinds of livestock. However, after the plant matures and the sharp spines form, it is worthless. It cannot be considered as a desirable forage plant on mountain ranges because livestock will not eat it if other and better forage is obtainable. On winter ranges it is often used by livestock after softening by winter storms. Russian-thistle is quite drought resistant and is extremely useful in the western prarie States during drought years. In many of the drought-stricken areas, this plant has been used successfully as emergency feed to prevent livestock from starving.

If cut when in bloom, before the sharp spines form, Russian-thistle makes good emergency hay. Even where cut after the spines have hardened, it may be chopped up and fed as fodder or silage. Westover *(208)* states that Russian-thistle is eaten readily by cattle

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FIGURE 23.—Russian-thistle (*Salsola kali* var. *tenuifolia* Tausch, syn. *S. pestifer* A. Nels.). Individual flower (at top), fruiting calyx and utricle with persistent styles (upper right).

in silage when cut nearly mature, mixed with half alfalfa one-third bloom, the silage being in good condition when opened and with a pleasant odor. If fed alone, especially during the fall, this plant has a very laxative effect, which may make it a source of danger,

particularly to cows in weak condition. This can be overcome by supplemental feeding with grain hay, first-cutting alfalfa, corn fodder, or straw *(40, 60, 61)*.

According to chemical analyses Russian-thistle contains more protein and carbohydrates than clover and as much or more ash or mineral salts than alfalfa or prairie hay, but it is less palatable and digestible than alfalfa. Its calcium and phosphorus content (2.3 and 0.22 percent, respectively) are relatively rather high *(206)*. Feeding tests have shown that Russian-thistle, ground into fodder, was 93.9 percent as valuable as cane fodder for fattening lambs. Robbins and Boyack *(167)* report that this weed is a favorite host plant upon which the sugar beet webworm lays its egs, the worms migrating from it to the beets.

An impure soda, known in the trade as "barilla," is obtained from burning plants of *Salsola* and the closely related genera *Salicornia* and *Chenopodium*. It is rather extensively imported into this country from Spain and other Mediterranean countries.

The variety *tenuifolia* differs from typical ***Salsola kali* L.** (syn. *S. tragus* L.), a maritime species of Europe and western Asia, chiefly in its narrower leaves and perhaps a greater tendency to broader fruiting calyces, but Fernald *(69)* adds "apparently showing no constant differences from those of the typical form."

Seepweed *(Suaeda)*

Seepweeds, often called sea-blite, are more or less fleshy annual or perennial herbs or undershrubs or shrubs found in salt marshes, dry alkaline lake beds, seashores, and other alkaline or saline sites. They have numerous alternate linear or cylindrical *(terete), but not spiny leaves*. The flowers are sessile in the axils of leaves or bracts and consist of a fleshy 5-parted *typically wingless* but often keeled or crested calyx; stigmas, 2 or 3, stamens 5. The often black and shining seeds have a flat spiral embryo. There are about 9 western range species of *Suaeda* of which 4 are more or less shrubby; for brief notes on the woody species see important Western Browse Plants *(54)*.

Under the International Code of Botanical Nomenclature *(114) Suaeda* Forsk. (1775) is conserved as against *Dondia* Adans. (1763). *Suaeda* is a Latinized form of Arabic *suwayd*, referring to an Old World species of the genus. Kearney and Peebles *(109)* mention the use of the leaves of these plants by Southwestern Indians for greens and medicine and of the seeds for "pinole." The following are reasonably representative of the range species.

Pursh seepweed [*Suaeda depressa (Pursh)* S. Wats., syn. *Dondia depressa* (Pursh Britt.], also known as Pursh's sea-blite, ranges from southeastern British Columbia, southern Alberta, Saskatchewan, and Manitoba, the Dakotas and western Minnesota, south to western Texas and coastal southern California, thence north to eastern Washington. In the typical form it is a prostrate annual or short-lived perennial, but is erect or nearly so in the **var. *erecta*** S. Wats. [syn. *S. erecta* (Heller) A. Nels., *Dondia erecta* (Heller) A. Nels.] and up to 3 feet or so high. Intermediate, decumbent or

ascending forms occur. The leaves are *broadest at the base;* the calyx lobes have *horned appendages;* the usually dense spikes may be short or long. In salt marshes and alkaline plains this plant may occur in almost pure stands and represent a distinct vegetal type.

As with other species of *Suaeda,* reported palatabilities for Pursh seepweed vary greatly. It has been observed to be heavily grazed at times and, when young, to be eaten by horses. Undoubtedly the time of the year, association and availability of palatable grasses and other plants, and salt hunger of animals are among the factors that govern the divergences of opinion as regards the forage values of seepweeds.

Black seepweed [***Suaeda nigra* (Raf.) J. F. Macbride,** syn. *Dondia nigra* (Raf.) Standl.] ranges from eastern Oregon and Idaho, through Nevada and Utah, into northern Mexico. It is an annual or rarely perennial with slender, erect, ascending or spreading, rather flexuous stems 8 to 30 inches high, the leaves *narrowed at base,* ¼ to 1 inch long but reduced and bractlike in the inflorescence. The palatability of black seepweed is ordinarily regarded as low.

***Suaeda diffusa* S. Wats.** [syn. *Dondia diffusa* (S. Wats.) Heller] is probably indistinguishable from *S. nigra.* This spreading form occurs from northeastern California and southeastern Oregon to southern Montana, western Nebraska, western Texas, and New Mexico.

Poison suckleya [***Suckleya suckleyana* (Torr.) Rydb.,** syns. *Obione suckleyana* Torr., *S. petiolaris* A. Gray][15] occurs from eastern Montana south to Wyoming, Colorado, and northern New Mexico. It is a fleshy, prostrate or decumbent-ascending annual, the herbage often somewhat reddish scurfy, with a taproot and branched stems 4 to 16 inches long. The rounded to rhombic-ovate, sharp- and wavy-toothed leaves are ⅜ to 1¼ inch wide. The flowers are produced in the axils of leaves and bracts, the 4-parted male flowers on top. The fruiting bracts closely invest the fruit, are spear shaped with crested margins, and tip two toothed.

The plant inhabits sink holes, pond, irrigation ditch, and stream borders, dry lake beds, and the like. While sometimes grazed by cattle and sheep with apparent impunity, it is known to have caused losses, due to hydrocyanic acid, to both kinds of stock. The hydrocyanic acid content varies considerably, appearing to be greatest in dry prairie sections and in soils rich in nitrates. Losses have been particularly noted around noon near water where this plant is plentiful and among nursing cows *(193, 202).*

AMARANTH FAMILY (AMARANTHACEAE)

This family consists of annual or perennial herbs (a few exotic species are undershrubs or woody vines), with simple opposite or

[15]The genus is monotypic, this being the only species known. It is named after its discoverer and first collector, Dr. George Suckley (1830–69), a United States Army surgeon of early Pacific railroad expeditions, and well known as a naturalist and ornithologist.

alternate leaves. The diminutive flowers consist of a 3- to 5- (occasionally 2-) lobed or parted, thin and dry calyx, with the same number of stamens opposite the lobes, or sepals, and distinct or united below into a tube; the flowers are mostly aggregated into axillary or terminal spikes, panicles, racemes, or heads; stigmas, 2 or 3. The fruit is a small 1-seeded nutlet or utricle, the lens-shaped seeds with a usually ringlike embryo. The range flora of this family consists of 9 genera and about 30 species. They are mostly homely, weedy plants. However, the family includes some rather common though somewhat coarse ornamentals, including **cockscomb (*Celosia argentea* L.)** and some species of *Amaranthus, Gomphrena,* and *Iresine,* which will be mentioned under those genera.

Hopiweed (*Acanthochiton wrightii* Torr.) is a smooth annual Southwestern herb, ranging from western Texas to Arizona and south into Chihuahua; it is the only known species of the genus. The branching stems are green and white striped. The small alternate leaves are narrow and awn tipped. Male and female flowers are usually borne on separte plants; male flowers are in clusters crowded into bractless spikes, with five perianth segments *(sepals)*; the female flowers have no floral envelope, or perianth, and are largely concealed by conspicuous heart-shaped, thin-margined, spine-tipped bracts, giving a prickly appearance.

The plant is often abundant in dry sandy places and sometimes becomes a troublesome weed in gardens. On the Jornada Experimental Range in southern New Mexico the plant was found worthless for cattle. However, Kearney and Peebles *(109)* report that, in Arizona, "while young the plants are relished by livestock." It is an important species in the economy of the Hopi Indians. Hough *(100)* states that it is known as the "ancient Hopi food," being gathered and strung by them in long bunches, which hang in nearly every house. The Hopi recount that this plant has warded off famine a number of times, springing up as it does before the corn is filled. Whiting *(209)* reports that it is "cooked as greens with meat," either when fresh in the spring or later and dried.

Waterhemp *(Acnida)*

This is a genus of smooth annuals, with the sexes distinct, having often elongated spikes or panicles of small greenish or yellowish flowers; the male flowers have a 5-lobed calyx; the female flowers are without a calyx. The fruit is a thin- or thick-margined 1-seeded nutlet, or utricle. To some people these plants resemble amaranth; others, hemp or nettle. The genus gets its scientific name from the latter viewpoint as it is from the Greek meaning "not nettle," having no stinging hairs. The group is somewhat peculiar in this family, because the favored habitat of most species is near or in water or in wet sites. There are two range species; the Forest Service has no report of either being grazed.

Tall waterhemp (*Acnida altissima* Riddell) ranges from Ontario to Kentucky and west to Colorado and South Dakota, growing along irrigation ditches, in flood plains, swampy places, and the like. It is an erect branching herb up to 6½ feet high, with lance-

shaped leaves broadest below the middle, the fruits opening irregularly, longer than the subtending bracts, the sepals of the male flowers sharp tipped.

Tamarisk waterhemp [*Acnida tamariscina* (Nutt.) Wood] occurs from Indiana to South Dakota, New Mexico, and Louisiana, often in waste places and sandy fields but preferring moist sites. It grows up to 5 feet high, has rhombic-oblong or oval leaves up to 4 inches long but the uppermost ones much reduced, the female spikes slender and elongated, the fruits opening in a ring at the top, the lobes of the male flowers shorter than the subtending bracts, long tapered and with an elongated tip.

Creeping chaffflower [*Alternanthera repens* (L.) Puntze, syn. *Achyranthes repens L.*] is a matted, more or less prostrate perennial herb, with a thick woody root, widely distributed in the warmer parts of the Eastern and Western Hemispheres. It is thought to have invaded our Southern States from Mexico and is now established from South Carolina to Florida and west to southern California. The leaves are opposite, oval or obovate and unequal in size. The flowers are in white-bracted short spikes from the leaf axils. The five lobes of the small flowers are pubescent with jointed hairs barbed at the tip. The plant is sometimes an aggressive weed in cultivated ground and is not known to have any forage value.

Amaranth *(Amaranthus)*

The type genus and namesake of the family, often called "pigweed" and "hogweed" because relished by swine, and "redroot" because of the root color of many species. There are about 17 western range species. Because they are aggressive, weedy plants, it is difficult to give the distribution of the species with exactness; the range of many is undoubtedly spreading. They are coarse annual herbs, with alternate stalked, untoothed (but sometimes wavy-margined) leaves; the small greenish (occasionally purplish or reddish) flowers occur in small compact clusters *(glomerules)*, these often arranged in spikes or panicles both terminal and from the leaf axils.

The sexes may be distinct or male and female flowers borne on the same plant; the flowers consist of a calyx with 2 to 5 distinct lobes, or sepals, the stamens with distinct stalks *(filaments)* and of the same number as the sepals. The fruit (a *nutlet* or *utricle*) may be nonsplitting *(indehiscent)* or open ringlike *(circumscissile)* at the top, discharging the single, shiny seed. Strange to say, in view of the coarse weedy character of the genus, at least two members are cultivated as ornamentals: **love-lies-bleeding *(Amaranthus caudatus* L.)** and **princess-feather *(A. hybridus* var. *hypochondriacus* Robins.)**.

Gilbert and colleagues *(79)* call attention to the fact that, under some circumstances, certain weeds, such as species of *Amaranthus*, may cause livestock poisoning or losses because of excessive accumulation of potassium nitrate (KNO_3), a common form of "saltpeter." This is particularly likely to occur in limey-shale soils and

shade; the nitrate content tends to decrease with plant maturity.

Prostrate amaranth (***Amaranthus graecizans*** **L.**, Syn. *A. blitoides* S. Wats.) is a prostrate, rather pale and relatively smooth, diffusely branched plant forming circular mats in cultivated and waste places, the stems 6 inches to 3 feet long. The spatula-shaped or obovate leaves are ¼ to 1 inch long, narrowed at the base into slender leafstalks. The 4- or 5-parted flowers are massed in small axillary clusters shorter than the leaves, subtended by oblong or lance-shaped bracts a little shorter than the flowers. The nearly smooth fruits open by a lid; the seeds are relatively large (1.6 mm. wide). It has often been confused with the related *A. albus* L.

Amaranthus graecizans appears to be indigenous from Washington east to Utah and Colorado and south into New Mexico, California, and Mexico, but is now found in nearly every State and in southern Canada, at least as a weed in cultivated ground. It is good hog feed and, on the Jornada Experimental Range (southwest New Mexico), has been reported as taken well by cattle.

Tumbleweed amaranth (***Amaranthus albus*** **L.**) resembles *A. graecizans*, and in some books they are treated as synonyms. This species differs from *A. graecizans* in being branched but erect, 6 to 24 inches high; it has much smaller seeds and much longer bracts in the inflorescence. As in *A. graecizans*, the flowers are in small axillary spikelike panicles shorter than the leaves. In the fall it is a "tumbleweed," often found near fence rows and embankments along with Russian-thistle and tickseed *(Corispermum)*. "Young plants are leafy and rather succulent, but in age the stems become rigid, yellowish, and covered with the very numerous spiny fruiting bracts and later, scale-like leaves which are also spiny-tipped" *(214)*.

In cultivated ground *Amaranthus albus* may be a troublesome weed. It is a frequent invader of newly burned areas. Like *A. graecizans*, it is sometimes used for ensilage. In the spring, when succulent and tender, it may be taken well by cattle; it sometimes causes bloating. The small black seeds are an important ingredient of the "pinole" meal used by Indians. Old settlers, as well as Indians, occasionally used this plant in the spring as a potherb.

Palmer amaranth (***Amaranthus palmeri*** **S. Wats.**), often called "carelessweed," "redroot," and, by Spanish-speaking people, "bledo" and "quelito," occurs from western Kansas and Colorado south, through southern California, Arizona, New Mexico, and western Texas, to central Mexico. It occupies plains, foothills, riverbanks, and valleys, and is often abundant and troublesome in irrigated land.

This species is an erect, branching, rather coarse herb 2 to 4 feet high. The rhombic-lance-shaped or reverse ovate leaf blades have conspicuously long stalks and are strongly veined beneath. Spikes are elongated and rather thick; the sexes are distinct; the lobes, or sepals of the male flowers are lance shaped and spiny tipped; those of the female flowers are clawed at the base, oblong or spatula shaped, distinct or nearly so, and up to one-eighth inch

long; the bracts subtending the flowers are awllike, sharp pointed and longer than the flowers.

The plant germinates after the summer rains and is killed by the first frost; it is regarded as fair to good summer cattle feed, though sometimes causing bloating. It is said to be easily crowded out where there is a good stand of native grasses. The species is named for its discoverer, Edward Palmer (1831–1911), well-known naturalist, explorer, and ethnobotanist.

Brayulinea [*Brayulinea densa* (Humb. & Bonpl.) Small] extends from northern South America north, through Central America and Mexico, to the southwestern border of the United States from western Texas to southern Arizona. It is a prostrate, matted, cottony perennial from a thick, deep, woody taproot; the opposite ovate leaves are cottony-pubescent beneath and unequal in size; the small 5-parted flowers are in dense cottony clusters from the leaf axils. The plant appears to be unpalatable to livestock and its marked increase on the range may be an indication of overgrazing. Dr. John K. Small (1869–1938) named the genus in honor of W. L. Bray and E. B. Uline, monographers of the North American Amaranthaceae.

Snakecotton *(Froelichia)*

Cotton-woolly or hairy, erect herbs, with opposite narrow sessile leaves; inflorescence in spikes, the flowers 5-cleft, the segments (sepals) united below, subtended by 3 thin bracts, the 5 stamens united into a tube. The genus is represented in the western range area by three species and is named in honor of Joseph Aloys Froelich (1766–1841), a German botanist. The plants furnish a limited amount of forage of fair to good palatability for cattle and sheep. They are sometimes called "cottonweed," a name better restricted to the European composite, *Diotis candidissima* Desf.

Arizona snakecotton (*Froelichia arizonica* Thornber) is a perennial with a thick woody root, often somewhat branched, and with thickish, reverse lance-shaped leaves. It occurs in grass types from western Texas to southern Arizona and northern Mexico.

Florida snakecotton [*Froclichia floridana* (Nutt.) Moq.], a Southeastern species extending as far north as Delaware, and which sometimes reaches a height of 6½ feet, is represented farther west, in the Great Plains and the eastern edge of the western range, by the variety **plains snakecotton [var. *campestris* (Small) Fernald,** syn. *F. campestris* Small] from South Dakota to Colorado, western Texas, and New Mexico. The variety has leaves broadest in the middle (instead of toward the base) and softer, shorter hairs on the inflorescence stalks.

Slender snakecotton [*Froelichia gracilis* (Hook.) Moq.] grows in sandy soils from western Texas to Arizona and northern Mexico. It is a slender, rather spindly annual, with thin, basal or near-basal, lance-shaped leaves, and fruits with two opposite lateral rows of toothlike projections. Adventive along railroad tracks, the plant has become locally established in the Eastern States.

Blake *(26)* reports it as a very aggressive weed on a farm in Anne Arundel County, Md.

Globe-Amaranth *(Gomphrena)*

Annual or perennial, small to medium-sized, leafy-stemmed or bare-stemmed *(scapose)* herb. Leaves opposite or sometimes whorled; flowers in dense, often globular heads or spikes, conpicuously enclosed by thin, variously colored bracts. The small flowers are 5 parted, the stamen stalks *(filaments)* united into a long tube, the 5 lobes of which are notched or 2-cleft at the tip. There are three native range species and, in addition, the cultivated, ornamental **common globe-amaranth** (***G. globosa*** **L.**), a native of the tropics, is occasionally naturalized. Palatability reports on these plants are somewhat inconsistent and more data are desired. Kearney and Peebles *(109)* report that, in Arizona, "the plants * * * grow on dry plains and slopes, usually with grasses (and) are eaten freely by cattle and probably other livestock." The species are sometimes called "ballclover" and "everlasting."

Tufted globe-amaranth (***Gomphrena caespitosa*** **Torr.**) is a low tufted perennial, with a deep thick woody taproot, stems up to 6 inches high with broad leaves at the base only; it occurs in New Mexico, Arizona, Sonora, and Chihuahua.

Shining globe-amaranth (***Gomphrena nitida*** **Rothrock**) is taller than *G. caespitosa,* has leafy stems, the leaves of an elliptic to ovate type, and the floral head usually subtended by two or more leaves. The type specimen has shiny pearly-white heads but these may be yellowish or pinkish. Unlike *G. caespitosa* and *G. sonorae,* the inflorescence bractlets are crested. The plant ranges from western Texas to southeastern Arizona and northern Mexico.

Sonora globe-amaranth (***Gomphrena sonorae*** **Torr.**), native to Sonora and Arizona, is an annual or perennial, with leafy stems and narrow leaves. As in *G. nitida,* the head is subtended by two or more leaves.

Bloodleaf *(Iresine)*

This is a largely tropical genus of herbs, some tropical species being shrubby. The leaves are opposite and stalked. The very small, thin, 5-parted flowers are crowded into spikes that are arranged in panicles; the stamen stalks *(filaments)* are united at the base into a sort of cup. The floral calyces in this genus are beset with long woolly hairs and, from this fact, the British botanist Patrick Brown (1720–90) devised the generic name from the Greek word *eiresiōnē,* meaning a wreath of olive or laurel bound round with wool, which was worn by Greek boys in two ancient festivals, who sang a song called by the same name. Two South American species, **Herbst bloodleaf** (***I. herbstii*** **Hook. f.**) and **Linden bloodleaf** (***I. lindenii*** **Van Houtte**) are much used as bedding plants in landscape gardening because of their brilliant red foliage.

There is only one known range species of the genus, **variable bloodleaf** (***Iresine heterophylla*** **Standl.**), which ranges from western Texas to southern Arizona and south into central Mexico. It is

a perennial up to about 40 inches high from a slender branching woody rootstock; the leaves are rather broad but vary greatly in size and shape; the yellowish or whitish flowers are in rather loose terminal panicles of spikes. Kearney and Peebles *(109)* report its occurrence in Arizona between elevations of 3,500 and 4,500 feet, usually in woodland or shrubby types. Notes on the palatability of this plant are lacking.

Tidestromia *(Tidestromia)*

This is a genus of more or less cottony or wooly, annual or perennial herbs or undershrubs, chiefly inhabiting dry sandy "desert" areas. They are prostrate, ascending or erect, with opposite leaves and bracted clusters *(glomerules)* of small, sessile, often yellowish flowers from the axils of a cluster of small leaves. The flowers consist of a 5-parted calyx, its lobes *(sepals)* united at the base; there are 5 stamens, their stalks *(filaments)* united below and often some additional undeveloped and sterile stamens *(staminodia)* are present; the stigmas are either simple or 2 lobed. In some species the flowers are sweet scented—whence the name "honeysweet."

In the older books the plants are often listed under the synonymous name *Cladothrix*, but that is a genus of lichens and its later use for a genus of flowering plants was illegitimate. There are three range species. The genus was renamed by the American botanist Paul C. Standley (1884–) in honor of Ivar Tidestrom (1864–1956), well known as author of floras of Utah and Nevada and of Arizona and New Mexico. The genus appears to have very limited forage value for domestic livestock but more data on that subject are needed.

Woolly tidestromia [***Tidestromia lanuginosa*** **(Nutt.) Standl.,** syn. *Cladothrix lanuginosa* Nutt.], ranging from Colorado, Utah, and Nevada to Arizona, New Mexico, and Texas, and south into northern Mexico, is a prostrate matted annual that has extended its range northward and eastward at least as far as South Dakota and western Kansas. The leaves are of an ovate, obovate or spatula-shaped type and are tapered at the base.

The forge value of this species is ordinarily considered worthless or low. Park *(153)* speaks highly of the possibilities of this plant for ornamental and protective planting in dry sandy soils of Texas. Kearney and Peebles *(109)* state that "the whitish mats of this plant are conspicuous soon after the summer rains on the deserts in southern Arizona and are well adapted for checking the blowing of sandy soils."

Honeysweet tidestromia [***Tidestromia oblongifolia*** **(S. Wats.) Standl.,** syn. *Cladothrix oblongifolia* S. Wats.] inhabits dry sandy "desert" areas from southern California to southern Nevada and Arizona. It is a perennial from a woody taproot and is sometimes almost an undershrub; the herbage is hoary white with branched *(stellate)* hairs; it is a spreading-ascending plant, the stems 8 to 24 inches long, with oblong to broadly ovate leaves usually longer than their stalks *(petioles)*.

Shrubby tidestromia [***Tidestromia suffruticosa*** **(Torr.) Standl.,**

syn. *Cladothrix suffruticosa* (Torr.) Benth. & Hook.] is an undershrubby plant of western Texas, possibly southeastern New Mexico, and northern Mexico. The leaves are squared or rounded at the base. Forage notes on it are lacking.

FOUR-O'CLOCK FAMILY (NYCTAGINACEAE, SYN. ALLIONIACEAE)

This family, chiefly confined to warmer climates, consists of annual and perennial herbs and undershrubs and, in the tropics, also of woody vines, shrubs, and small trees. The stems often have swollen joints; the leaves are mostly opposite. The flowers, often showy, are subtended by bracts or these may be united into a calyxlike involucre. The *perianth,* or immediate floral envelope (and usually the showy part of the flower) suggests a true corolla and may be bell, funnel, or salver shaped, 4 or 5 toothed or lobed at the apex, the base of the lower, tubular part persistent, hardening and closely investing the fruit. The dry fruit is usually ribbed, grooved or winged and envelops a free achene, or "seed."

To this family belong a considerable number of cultivated ornamentals, including the familiar **four-o'clock,** or "marvel-of-Peru" (***Mirabilis jalapa* L.**), the celebrated bouganvillea vines of the tropics, and certain species of sandverbena *(Abronia).* The latest monograph of our species of this family is by Standley *(187)* in 1918, in which 17 genera and 101 species are listed as occurring in the western part of this country; however, majority botanical opinion probably favors reduction of 4 of these genera and many of the species to synonymy.

In addition, in southern Florida, is an herbaceous genus of this family *(Okenia)* and 2 genera *(Pisonia* and *Torrubia),* listed in Little's Check List *(121),* with 6 species, 4 of small trees and 2 of shrubs. The 5 best-developed range genera of the family are: *Abronia,* with about 25 range species; *Boerhaavia* and *Mirabilis,* with about 14 species each, and *Acleisanthes* and *Oxybaphus,* about 7 species each. The family name Nyctaginaceae has been formally proposed for conservation.

Sandverbena *(Abronia)*

This is the best developed and perhaps most widely distributed of the western genera of this family. The species are perennial or sometimes annual, usually sticky-hairy, spreading, ascending or erect herbs. The often thickish and fleshy leaves are opposite, untoothed or wavy margined, of a lance-shaped, elliptic or ovate type, frequently oblique at the base. The flowers are several to numerous in umbellike heads, more or less fragrant, white, pink, yellow or red, salverform or funnelform, the tube long and slender, the upper flaring part *(limb)* 5 lobed, subtended by an involucre of thin bracts; stamens 5 (occasionally 4), small and included within the flower tube. Fruit winged or deeply lobed, the wings or lobes thickish and opaque. Often showy plants and some of them in ornamen-

tal cultivation, growing naturally in sandy, sunny places, dry streambeds, and the like.

The following three species are reasonably representative of the genus:

Redstem sandverbena (*Abronia elliptica* A. Nels.) ranges from Wyoming (also in Gem County, Idaho) and Colorado to Utah and northern and central Arizona and New Mexico. It has a thick woody root and crown, trailing or semierect stems usually with a peculiar reddish tinge, greenish-white flowers subtended by an involucre of broad bracts which Standley *(185)* states "usually have a reddish or purplish tinge below which is characteristic of this species alone." The top-shaped, obscurely hairy fruit usually has five narrow wings with rounded, blunt tips.

Mostly in "desert" areas; up to 8,000 feet in Colorado *(90)*. Collected in southeastern Utah as 7,000 feet, south slope, sandy loam soil, in a grass-weed type. So far as known this plant has little, if any, forage value but more data are desired. It is closely related to the next species, of which some deem it to be a variety.

2. **Snowball sandverbena (*Abronia fragrans* Nutt.)** ranges from South Dakota to Idaho, and south to Arizona, Mexico, Texas, Nebraska, and Iowa. It has very fragrant white flowers and differs from *A. elliptica* chiefly in the narrower inflorescence bracts and the paler, different-shaped fruits that are squared at the top and narrowed below. It is cultivated as an ornamental. The forage value seems to be nil or very limited but more data are desired. The thick farinaceous root is said to have been eaten occasionally by Indians. It has been recommended as a perfumery plant *(168, 180)*.

3. **Yellow sandverbena (*Abronia latifolia* Eschsch.)** occurs from Vancouver Island and British Columbia to Santa Barbara County, California. It is especially well developed on beaches and dunes near the Pacific but is found farther inland on sandy soils. It is a trailing, almost vinelike plant, with rooting stems and a stout, spindle-shaped or cylindrical taproot up to 2 inches thick and 1½ feet or so long, with ropelike, spongy branches often several feet long. The leaves are round or nearly so. The flowers are yellow, with a somewhat orangelike fragrance; numerous, trumpet shaped with 5 lobes, about ½ inch long. The fruit is leathery, broadly top shaped, almost squared *(truncate)* at the tip, with usually five narrow, thick, hollow wings.

Smith *(182)* quotes Leckenby to the effect that this species "furnishes some pasturage for cattle, besides being an excellent soil-binder"; aside from this note, palatability data on the plant appear to be lacking. The species is used to illustrate the genus in Bailey's *(8)* Cyclopedia of American Horticulture where it is stated that the plant is useful as an ornamental "for baskets and rockeries." Watson *(207)* and Schneider *(180)* indicate that the root is sometimes eaten by Indians.

Very close botanically to the genus *Abronia* is **sandpuffs *(Tripterocalyx)***. This is a group of 5 species occupying the area from Utah and Nevada to Arizona, New Mexico, Texas, and northern Mexico, except that 1 species reaches California and another [*T.*

***micranthus* (Torr.) Hook.**] goes north as far as Montana, North Dakota, and western Kansas. The forage values appear to be the same as those of *Abronia* but more data are desired. They are succulent annuals differing chiefly from *Abronia* in the flower lobes and stamens being typically 4 (instead of 5), and in the conspicuous, thin, net veined, fishscalelike wings completely covering the body of the fruit.

Longtube angel-trumpet *(Acleisanthes longiflora* A. Gray)[16] is a rather spectacular, woody-rooted, more or less trailing perennial growing in "desert" sites from southern California to west Texas and northern Mexico. The opposite leaves are entire or wavy margined, thick, the blades somewhat triangular or rhombicovate or lance shaped. The white or purple-tinged flowers, terminal or from the leaf axils are usually solitary, fragrant, night blooming, with a long slender tube 4 to 8 inches long, the tip flaring and 5 lobed. The fruit is cylindrical or oblong and 5 angled or ribbed. Called in California "yerba-de-la-rabia." Data are lacking regarding the palatability of this plant, but it is probably not abundant enough to have any forage significance.

Acleisanthes is represented by seven (chiefly Texan) western species. Parks *(153)* warmly recommends the ornamental cultivation of *A. longiflora* and also of the tree-climbing, smaller, and late-afternoon flowering ***A. obtusa* (Choisy) Standl.** He also recommends for ornamental cultivation the annual, triangular-leaved, brilliantly red-flowered ***Nyctaginia capitata* Choisy,** which he calls "devils-bouquet." It is a relative of this family and is said to resist the hottest, driest weather.

Allionia *(Allionia,* syns. *Wedelia* Loefl., *not* Jacq., *Wedeliella)*

Allionia[17] is a genus of prostrate-trailing annual or perennial herbs, with opposite, stalked, mostly fleshy and untoothed or wavy-margined leaves. The flowers are bell shaped or flaring (campanulate-rotate), usually in 3-flowered, stalked involucres. The fruits are strongly flattened, oval or obovate in outline, the back *(dorsal)* side with two rows of stalked glands, the margins usually toothed and inbent over the back face.

Allionia and *Oxybaphus* are much confused in many of the books. Umbrellawort *(Oxbaphus)* has very different fruit, which is not

[16] *Acleisanthes* is derived from two Greek words plus alpha privative, signifying "flower not shut up," alluding to the lack of a basal involucre. The name angel-trumpet for this genus is objected to by some, but the name does not appear to be in use for other plants except for floripondio datura (*Datura arborea* L.) and perhaps also for the related angeltears datura (*D. suaveolens* Humb. & Bonpl.), two tropical-American small trees or large shrubs of the jimsonweed genus, which are often called "angels-trumpet," and the former "reina-de-la-noche."

[17] *Allionia* L. (1759) is conserved, under the International Code, as against *Wedelia* Loefl. (1758). This also has enabled conservation of the otherwise homonymous *Wedelia* Jacq. (1760) for a genus of composites. *Wedeliella* Cockerell (1909) was published to replace (the at that time untenable) *Wedelia* Loefl.

at all flattened, distinctly 5 angled rather than with the margins toothed and infolded; the plants tend to be more ascending and erect than prostrate-trailing as in allionia; the involucres are conspicuously veined, usualy have more flowers than in allionia, and become papery and greatly enlarged in fruit. There are three or four range species of allionia, but trailing allionia is probably the commonest and best known.

Trailing allionia [***Allionia incarnata*** **L.**, syns. *A. divaricata* Rydb., *Wedelia incarnata* (L.) Kuntze, *Wedeliella incarnata* (L.) Cockll.] is often called "cartwheel," "gunaninpil," "purple-creeper," and "trailing four-o'clock." This is a perennial trailing sticky herb, the stems 4 to 30 inches long, found from western Texas to Colorado, Utah, Nevada, southeastern California and south, through Arizona and New Mexico, to Mexico, the West Indies and, in South America, as far as Chile and Argentina. Venezuela is the type locality. The leaves are typically ovate or oblong. The small flowers are rose colored or occasionally white, 3 in each of the 3-lobed involucres. The leathery fruits are about ⅛ inch long or a little more and incurved. The plant is found in sandy soils, washes, woods, valleys, canyons, riverbanks, dry hills, etc., from the paloverde-creosotebush type to the woodland type.

The palatability of trailing allionia varies with the season, and the presence and available amount of more palatable grass and other forage. Thornber *(201)* reported the plant to be of considerable value on many summer Arizona ranges. Smith *(182)* stated that is "comes up from the seed after the summer rains in * * * Arizona and New Mexico, and furnishes a palatable and nutritious food for sheep and cattle. It stands pasturing well, and usually ripens an abundance of seed."

Spiderling *(Boerhaavia)*

This is a genus of annual or perennial herbs, mostly branched from the base and often with the stem joints sticky-banded. The very small flowers (particularly so for this family) are in terminal racemes, cymes, umbels or heads, from an involucre of distinct bracts; the *perianth*, or conspicuous corollalike part of flower, bell shaped to flaring, chiefly 5 lobed. The fruit is characteristically more or less club shaped and 5 (occasionally fewer) ribbed. Named by Linnaeus for his patron and friend, the celebrated Dutch physician, professor and savant of Leyden, Hermann Boerhaave (1668–1738), teacher of Peter the Great.

The following two species are representative of the western range members:

1. **Scarlet spiderling** ***(Boerhaavia coccinea*** **Mill.**, syns. *B. caribaea* Jacq., *B. viscosa* Lag. & Rodr., *B. viscosa* var. *oligadena* Heimerl) is a variable, widely distributed perennial herb—possibly sometimes annual or biennial at the northern edge of its range, ranging from tropical America to Florida, Texas, New Mexico, and Arizona; reported as occasionally naturalized farther north. It has many stout, sticky-hairy, trailing stems 1 to 5 feet long; opposite, rounded, ovate or oblong leaves, either smooth or sticky,

up to 2½ inches long, pale below and often with a brown-dotted margin.

The flowers are red to purplish, in cymes, the stamens 1 to 3. The fruits are sticky, helping in their dissemination. In the Southwest in sandy deserts, washes, along roadsides, old fields and waste places, and also rather dry loamy sites, open grassweed types, at medium and low elevations. Sometimes a troublesome weed in gardens. It is ordinarily unpalatable to domestic livestock. Forest Service employees in southeastern Arizona have reported its value as "none."

2. **Erect spiderling** [***Boerhaavia erecta* L.**, syns. *B. erecta* var. *thornberi* (M. E. Jones) Standl., *B. thornberi* M. E. Jones] occurs from tropical America north to the southern part of the United States from South Carolina to Florida, west to Louisiana, Arkansas, Texas, New Mexico, and Arizona. It is an erect annual, often branched from the base, the branches spreading and 1 to 4 feet long. The leaves are of an ovate or triangular-ovate type, the lower surfaces whitish to cottony and minutely black dotted.

The small flowers are white or purplish, on stalks usually more than 2 mm. (1/12 inch) long, in loose heads arranged in racemes or umbels. The hairless, ribbed fruits are unwinged and with a flattened tip. In the var. ***intermedia* (M. E. Jones) Kearney & Peebles** (syn. *B. intermedia* M. E. Jones), the stems are shorter, the inflorescence more compact and umbellike, and the fruits smaller. In sandy or gravely soils, waste places, fields, roadsides, dry washes, and the like, up to about 5,700 feet. Of little or no value; occasionally nibbled by sheep and cattle.

Slim spiderling ***(Boerhaavia gracillima* Heimerl)** (fig. 24) occurs on sandy-gravelly-rocky plains and foothills, between elevations of about 2,500 and 4,500 feet, from western Texas to Arizona and south in Mexico to Lower California and Oaxaca. It is a much-branched, slender-stemmed perennial from a thick woody root and crown. The plant is hairless *(glabrous)* or somewhat puberulent, *never glandular*. The flowers are red, solitary, on long slender stalks *(pedicels)*. The small fruits are beset with more or less spreading hairs. It is not known to have any forage value.

Hermidium ***(Hermidium alipes* S. Wats.)** is the only known member of its genus and occurs in lower foothills from California to Nevada and Utah. It is a bluish, erect or ascending, rather stout herb with paired *(dichotomous)* branches, perennial from a thick woody taproot. The broad thick leaf blades are rounded to ovate or oval, up to 3 inches long. The purplish-red or light-purple flowers, up to 1 inch long, are in headlike clusters of about 6, each flower attached to a large and leaflike bract. The fruit, about ¼ inch long, is a little narrowed at each end, smooth or a little roughened. A Forest Service employee found this plant "common in bare spots in roads" in an area at 5,000 feet in western Utah. Forage values of the species are probably negligible to low.

Watson *(207)* described the genus and species in the botany of the King Exploration, where a fine plate of the plant appears. The significance of the name *Hermidium* is a bit obscure; appar-

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FIGURE 24.—Slim spiderling (*Boerhaavia gracillima Heimerl*). Individual flower and fruit (lower left-hand corner).

ently it is a diminutive of Hermes (Mercury) and perhaps may refer to a fancied resemblance of the large flower bracts to the winged sandals or winged cap *(petasos)* of that Graeco-Roman god.

Four-O'Clock *(Mirabilis,* syns. *Allioniella, Hesperonia, Quamoclidion)*

This group consists of perennial herbs with thick woody roots and usually broad leaves. The salver-shaped, funnelform or sometimes bell-like *(campanulate),* often brightly colored flowers are solitary or several in a calyxlike involucre that *does not become conspicuously enlarged and papery in fruit;* stamens 3 to 5. The small hard fruits are *not strongly 5 angled* but may be 5 ribbed; they are smooth or minutely warty. *Allioniella* and *Quamoclidion* (considered by some to be distinct genera) differ from typical *Mirabilis* in having the involucres more than 1 flowered; the *Allioniella* and *Hesperonia* sections have a very short perianth tube; *Allioniella* and *Quamoclidion* have a bell-like *(campanulate)* flower *(perianth).*

The best known member of the genus is the **common four-o'clock** of the gardens **(*Mirabilis jalapa* L.)** which derives its common name from the fact that its flowers open in the latter part of the afternoon. Linnaeus obviously called the genus *Mirabilis* (meaning marvelous, or wonderful) because of the common name then current "marvel-of-Peru." Before him Tournefort called the genus *Jalapa* and Linnaeus attached that name to the common four-o'clock, the root of which at one time was considered a cathartic. Tournefort perhaps confused this plant with the quite different true medicinal **jalap [*Exogonium jalapa* (L.) Baillon,** syns. *Convolvulas jalapa* L., *Ipomoea jalapa* Coxe (1830) *not* Pursh (1814), *Ipomoea purga* Hayne, *Exogonium purga* (Hayne) Lindl.].

Wishboneplant, or Bigelow four-o'clock [*Mirabilis bigelovii* A. Gray, syn. *Hesperonia bigelovii* (A. Gray) Standl.] is a very sticky-hairy, erect or spreading perennial, somewhat undershrubby at base. The leaves, a little less or a little more than 1 inch long, are rounded to triangular ovate, somewhat heart shaped or rounded at base. The white or pinkish flowers are ¼ to ½ inch long, solitary in involucres about ¼ inch long, their triangular lobes shorter than the united lower part *(tube).* The plant occurs in desert canyons and the like from southern Nevada, southern California, and Arizona south into Sonora.

Mirabilis bigelovii is conspicuously repeatedly branched in pairs *(dichotomously)*—giving an appearance of successive "wishbones" —whence the common name. The scientific name commemorates Dr. John Milton Bigelow (1804–78), U. S. Army surgeon with the Mexican Boundary Survey of 1853 and the eponym of many western plants. The variety ***retrorsa* (Heller) Munz** [syns. *M. retrorsa* Heller, *Hesperonia retrorsa* (Heller) Standl.] differs only in that the lower part of the stems is occasionally hairless *(glabrous)* and the pubescence is rougher and downbent *(retrorse).* The plant appears to be disregarded by domestic livestock.

Longtube four-o'clock ***(Mirabilis longiflora*** **L.)** occurs from western Texas to Arizona and south into Mexico. It is sometimes as much as 5 feet high and is usually very sticky-hairy—at least in the inflorescence. The conspicuous feature of the species is the extraordinarily long (3 to 7 inches) and slender tube of the whitish (usually tinged with pinkish or purplish) flowers, with abruptly flaring mouth and long-exserted stamens. The **var.** ***wrightiana*** **(A. Gray) Kearney & Peebles** (syn. *M. wrightiana* A. Gray) differs from the typical form of the species in that the leaves are usually distinctly stalked *(petioled)* and the stems are minutely hairy rather than conspicuously viscid, or sticky. This variety is named for Charles Wright (1811–85), the well-known early botanical explorer of the Southwest.

The **common four-o'clock** ***(Mirabilis jalapa*** **L.)**, native of tropical South America, Central America, and Mexico, is native also in the United States in western Texas. It has escaped from cultivation in many parts of the world. So far as the writer knows there is no reference to this plant in toxicological literature, but Degener *(57, Fam. 113)* says that the seeds and roots are poisonous. He adds that "the mealy endosperm of the seeds was used in Korea and Japan as face powder. The plant is still occasionally used by the Hawaiians as a medicine, and the fruits are employed in making necklaces."

Colorado four-o'clock [*Mirabilis multiflora* (Torr.) A. Gray, syn. *Quamoclidion multiflorum* Torr.] (fig. 25) ranges from (western and southern) Colorado and Utah to southern California, east, through Arizona and New Mexico, to western Texas and south into Mexico. A diffusely branched herb perennial from a deep, thickened woody root; stems stout, up to about 40 inches long. The rose-colored to purplish-red and purple flowers are large (up to 2 inches long) and showy, up to 6 together in a large calyxlike involucre, whose 5 triangularly lobed bracts are united for at least half their length. Flowering period, June to September. Fruit hard, smooth, dark brown to black, not angled and not narrowed at base.

Watson *(207)* notes "flowers open from four o'clock in the afternoon till nine in the morning." Mostly in partly shaded sites on plains, foothills, and valleys, and in the mountains between about 4,000 and 9,000 feet. Although occasionally observed to be grazed by goats, cattle, and sheep, the plant is generally regarded as having little or no forage value. However, it has excellent possibilities for ornamental cultivation. Standley *(186)* has a fine photographic plate (No. 77, opposite p. 411) of this plant in full bloom. Kearney and Peebles *(109)* refer to reports that the Hopi Indians "eat the root to induce visions" and that "the powdered root is used as remedy for stomach ache."

Umbrellawort four-o'clock [*Mirabilis oxybaphoides* A. Gray, syns. *Allioniella oxybaphoides* (A. Gray) Rydb., *Quamoclidion oxybaphoides* A. Gray], perennial from a thick fleshy root, occurs in the woodland and ponderosa pine types from southern Colorado and Utah to northern Arizona, New Mexico, and western Texas. The

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FIGURE 25.—Colorado four-o'clock (*Mirabilis multiflora* (Torr.) A. Gray, syn. *Quamoclidion multiflorum* Torr.).

herbage is sticky-hairy when young but becomes smoother as the season advances; the many branches are slender, green or whitish, the plants often occurring in dense tufts up to 4 feet in diameter. The small ¼ to ⅔ inch long) flowers are 3 in a saucer-shaped involucre that enlarges in fruit; they are bell-funnel-shaped, the tube very short; stamens 3, their stalks *(filaments)* separate. The plant is often abundant locally but scattered in occurrence. The forage value is low or nil.

Umbrellawort *(Oxybaphus)*

Perennial herbs, varying in habit from low and trailing to tall and erect, with opposite and usually rather thick leaves. The flowers are somewhat oblique, bell shaped to short funnelform, small—less than 1 inch long, in 1- to 5-flowered calyxlike, united, net-veined involucres conspicuously enlarging and becoming papery in fruit; stamens 3 to 5, unequal in length. The fruit is 5 angled, constricted at the base, reverse egg shaped with the broader end uppermost; mucilaginous when wet.

Sticky umbrellawort [*Oxybaphus comatus* (Small) Weatherby, syns. *Allionia comata* Small, *A. melanotricha* Standl., *O. melanotrichus* (Standl.) Weatherby] ranges from western Texas to extreme southwestern Colorado, New Mexico and Arizona, and south into Mexico, from foothills to the ponderosa pine and spruce-fir belts. It is an erect, sticky-hairy perennial, 1 to 4 feet high, with opposite leaves varying from elongated triangular to lance-ovate or ovate, and usually 1½ to 4 times longer than wide. The flowers vary from purplish red to pink. This plant has been reported to be fair to good sheep and cattle feed from June to October.

Hairy umbrellawort [*Oxybaphus hirsutus* (Pursh) Sweet, syns. *Allionia hirsuta* Pursh, *A. pilosa* (Nutt.) Rydb., *Mirabilis hirsuta* (Pursh) Mac.M.] is an erect or decumbent, more or less hairy-stemmed perennial 1 to 4 feet high, with linear-lance-shaped to oblong leaves, purplish or pinkish flowers, and hairy fruit. It occurs in dry sandy soils and has an unusually wide range in the United States from Wisconsin and Minnesota south to Louisiana and Texas, and west to New Mexico, Colorado, Wyoming, Montana, and Saskatchewan. Forage data on this plant are in some conflict, and more data are desired. Biochemical studies in this family might prove of considerable interest.

Narrowleaf umbrellawort [*Oxybaphus linearis* (Pursh) Robins., syns. *Allionia divaricata* Rydb., *A. linearis* Pursh, *O. angustifolius* Sweet] (fig. 26) is a typically bluish and smooth (at least below) perennial herb, with slender erect stems up to 4 (rarely 5) feet high, found from Illinois and Minnesota south to Louisiana and Texas, and west to Arizona, Nevada, Utah, and eastern Montana. The inflorescence and fruit and often the upper parts of the stems are more or less hairy.

In the typical form the thick, opposite stalkless *(sessile),* or nearly so, leaves are linear or narrowly lance shaped ½ to 2½ inches long; the small flowers are purplish or pinkish and appear from June to October. The fruit is usually roughened between the five ribs. The **var. *decipiens* (Standl.) Kearney & Peebles** (syn. *Allionia decipiens* Standl.) has broader (sometimes ovate-lance-shaped), short-stalked leaves. The **var. *subhispida* (Heimerl) Dayt.** [syns. *Allionia gausapoides* Standl., *A. linearis* var. *subhispida* (Heimerl) Standl., *A. subhispida* (Heimerl) Standl., *Mirabilis linearis* var. *subhispida* Heimerl] has densely hairy stems.

The plant occupies rather dry to medium moist, sandy or gravelly soils—sometimes also heavy clays and moist rich loam—from

FIGURE 26.—Narrowleaf umbrellawort [*Oxybaphus linearis* (Pursh) Robins., syns. *Allionia divaricata* Rydb., *A. linearis* Pursh, *O. angustifolius* Sweet]. *A, Involucre* and expanded flower; *B,* fruiting involucre and fruit.

"desert" areas to the ponderosa pine type, often in partly protected sites, as under mesquite bushes or under cottonwoods in canyons. As a rule, this plant is eaten only a little, if at all, by cattle and sheep.

Scarlet umbrellawort [*Oxybaphus coccinea* Torr., syn. *Allionia coccinea* (Torr.) Standl.] of woodland-grass and ponderosa pine types, of Arizona, New Mexico, and Sonora, is rather closely related to *O. linearis*. It has relatively large (up to 4/5 inch long) red flowers and is reported by Kearney and Peebles *(109)* to be "the showiest of the Arizona species."

The following southwestern plants of this family are not known to have forage significance, but more information about them is solicited: **Sandbell [*Ammocodon chenopodioides* (A. Gray) Standl.,** syn. *Selinocarpus chenopodioides* A. Gray]; 3 species of **gumjoint *(Anulocaulis);*** the somewhat vinelike **gumseed [*Commicarpus scandens* (L.) Standl.]** with very sticky fruits; ***Cyphomeris gypsophiloides* (Mart. & Gal.) Standl.** [syn. *Senkenbergia gypsophiloides* (Mart. & Gal. Benth. & Hook.];[18] and 4 species of **moonpod *(Selinocarpus).***

PORTULACA FAMILY (PORTULACACEAE)

Mostly annual or perennial, often succulent herbs, the leaves alternate, opposite or basal and untoothed. Flowers with 2 sepals, 3 to many petals, 4 to many stamens, 2 to 8 (often partly united) styles; ovary 1 celled, superior (partly inferior in *Portulaca).*

Fruit, a capsule, opening by a circular slit *(circumscissile)* at the top or by longitudinal valves; seeds 1 to many, chiefly more or less rounded or kidney shaped and somewhat flattened. The family, which is of very minor significance from the forage standpoint, is represented in the western range area, on a conservative basis, by 8 genera and about 73 species. Considering its relatively small size, the family is well represented in ornamental cultivation, the flowers of many of the genera and species being attractive.

Rockpurslane *(Calandrinia)*

This is a large, mostly South American and Australian genus of annual or perennial herbs, with short-lived, mostly 5-petaled and red or white flowers with 2 persistent sepals, and 3-valved capsular fruits containing numerous dark seeds. The genus, represented in the western range area by about five species, has very little forage value. It is named for J. L. Calandri (1703–58), a botanist of Geneva, Switzerland.

Redmaids [*Calandrina ciliata* (Ruiz & Pavon) DC. and variety ***menziesii* (Hook.) J. F. Macbride,** syn. *C. caulescens* var. *menziesii* (Hook.) A. Gray] ranges from near sea level, chiefly west of the Cascades and Coast Ranges, in open, often moist, sunny places

[18]The generic name *Cyphomeris* was published by Standley to replace the homonymous and untenable *Senkenbergia* Schauer (1847), *not Senckenbergia* Gaertn., Mey. & Scherb. (1800) which latter, in turn, is a synonym of the mustard family pepperweed genus *Lepidium.*

from near sea level to the ponderosa pine belt, from British Columbia to Lower California and, less commonly, in Arizona and Sonora. It is a small annual, with narrow leaves, rose red flowers about 3/8 to 3/4 of an inch broad, in racemes appearing in early spring, and numerous, black, shiny, minutely warty seeds. It is cultivated as an ornamental but is negligible as forage.

Calyptridium *(Calyptridium)*

Calyptridium is a genus of (conservatively) 4 species confined to western North America and, with one exception, to the 3 Pacific States, Lower California, Sonora, Arizona, and Nevada. They are all small annuals with numerous spreading stems, with basal and alternate largely spatula-shaped leaves, small flowers in 1-sided and often twisted spikes or spikelike panicles, 2 broad somewhat fused sepals unequal in size, 1 to 3 stamens, and a short style with 2 stigmas. The fruit is a 2-valved capsule with flattened seed. The name *Calyptridium* is a Latinized diminutive of the Greek καλύπτρα (a woman's veil or the cover of a quiver) and refers to the fact that the 2 to 4 petals soon dry and, persisting, fold like a sort of cap on the fruit. The plants occur mostly at the lower elevations and, as a rule, have no forage value.

Rosy calyptridium ***(Calyptridium roseum*** **S. Wats.)** occurs in eastern Oregon and California, through Nevada, and has been reported from Wyoming. It has been suspected to occur in Idaho but apparently has not yet been collected there.

Springbeauty *(Claytonia)*

Smooth herbs perennial from deep-seated bulblike corms or with fleshy taproots or rootstocks. There is a solitary or several basal leaves and usually two opposite or subopposite stem leaves, with occasionally a third leaf present. The pink, white or yellow flowers have 2 sepals, 5 (sometimes 6) petals, and 5 stamens. The fruit is a 3-valved capsule with 2 to 6 black or blackish shining seeds. The genus is named for Dr. John Clayton (1693–1773) whose extensive collections of Virginia plants were sent to the famous Dutch physician and botanist Gronovius and published by him in Flora Virginica (1762).

Claytonia is especially well developed in the western range area where about 15 species occur—the number varying in the literature because of confusion with the genus *Montia*. The palatability of these delicate little plants to domestic livestock, deer, and elk is fairly good or good but they appear early in the spring (often flowering right out of the edge of melting snowbanks), are evanescent, and the amount of herbage produced is slight, so that their forage value is rather insignificant. Hogs are fond of the corms of those species which produce them and which are sometimes called "Indian-potato." Some of the species are cultivated in wildflower gardens.

Two of the commonest range species are **lanceleaf springbeauty** ***(Claytonia lanceolata*** **Pursh,** syn. *C. multiscapa* Rydb.), a lance-

leaved, cormose plant with purple-veined rose-colored flowers, ranging from British Columbia and Alberta to California and New Mexico, and **alpine springbeauty** [***C. megarrhiza* (A. Gray) Parry**, from which *C. bellidifolia* Rydb. is somewhat doubtfully separable] a high-range plant with tufted basal leaves and a thick taproot, occurring from southeastern British Columbia to western Montana and south to northeastern Oregon, Utah, and New Mexico.

Lewisia (*Lewisia*, syns. *Erocallis, Limnia* in part, *Oreobroma*)

The genus honors Capt. Meriwether Lewis (1774–1809) of the Lewis & Clark Expedition and first Governor of Louisiana Territory. This is a variable group of about 15 western range species; they are smooth perennial herbs with rounded bulblike corms, or thick, often branched taproots or occasionally fibrous rooted. The leaves are largely basal, those of the stem often much reduced. The mostly white or pinkish, short-lived flowers vary from small to large and showy, solitary or in umbels or other types of clusters, with 2 to 6 persistent sepals, 4 to 18 petals, 3 to 8 styles united at base, 5 to many stamens, superior ovary and more or less rounded fruiting capsules that open horizontally *(circumscissile)* near the base and then split toward the apex. The forage value is low; some species are cultivated in wildflower gardens. Indians and early settlers used the roots of many of the species for food—to which the name of the synonymous genus *Oreobroma* ("mountain food") refers.

The best known species of this genus is **bitterroot** ***(Lewisia rediviva* Pursh)** (fig. 27), the State flower of Montana and namesake of the Bitterroot Mountains and Bitterroot National Forest, which occurs at considerable altitudinal variation in the mountains from British Columbia to Montana, Colorado, Utah, and California. Some of the books record it from Arizona and New Mexico, but this apparently is questionable. This interesting low rosette plant, with fleshy bitter roots and showy rose-colored or white flowers, was illustrated with a colored plate and extensively annotated in the Range Plant Handbook *(204)*.

Another common member of the genus is **least lewisia** [***Lewisia pygmaea* (A. Gray) Robins.**, syns. *Oreobroma pygmaeum* (A. Gray) Howell, *O. grayi* (Britton) Rydb.], a high-mountain dwarf herb occurring from Washington to Montana, Colorado, northern New Mexico, and California. It has stems 1 to 2 inches high, succulent narrow leaves longer than the inflorescence, and flowers with 6 to 8, white or pinkish petals about ⅜ inch long, appearing from June to August. Sheep are sometimes observed to nibble it but it is too small to have much forage value. The farinaceous root has only a slight degree of astringency and had some importance as a food plant of Indians.

FIGURE 27.—Bitterroot (*Lewisia rediviva* Pursh). (Photo courtesy Thomas Lommasson.)

Indianlettuce (*Montia*, syns. *Crunocallis, Limnia* in part, *Montiastrum, Naiocrene*)

Montia, with about 20 western range species, the exact number somewhat questionable because of confusion in some of the books with *Claytonia,* is a group of annual or perennial herbs with fibrous roots or reproducing by runners or bulblets. The leaves are basal, opposite or alternate, often fleshy. The pink or white flowers, in racemes or panicles, have 2 persistent sepals; 2 to 6, often partly united petals; 2 to 5 stamens; 3 styles, partly united; 3 (rarely 4) ovules, and 3-valved, globular or egg-shaped capsules with 1 to 3, often shiny seeds. The genus commemorates Giuseppe Monti, an Italian physician and botanist, who published a botanical index and materia medica in 1724 and a treatise on poisonous plants in 1755.

Some of the species of *Montia* have limited value for livestock and wildlife. The five species briefly annotated here are probably the commonest of the range members:

1. **Asarumleaf Indianlettuce [*Montia asarifolia* (Bong.) Howell,** syns. *Limnia asarifolia* (Bong.) Rydb., *Claytonia asarifolia* Bongard] occurs in moist sites, springy places, streambanks and the like, in the high mountains from Alaska to Idaho, western Montana, and California. It is perennial from short, creeping scaly rootstocks; the slender scapelike stems are 4 to 12 inches tall; there

are long-stalked, ovate, heart-shaped or kidney-shaped basal leaves, and stalkless stem leaves. Considered fair to good elk and deer feed in spring and summer; noted sometimes to be nibbled by sheep. Occasionally used by natives as a potherb.

2. **Siberian Indianlettuce [*Montia sibirica* (L.) Howell,** syn. *Claytonia sibirica* L.] is very close to *M. asarifolia* botanically, and it has a similar American range. Also occurs in Siberia. It is taller than *M. asarifolia* (sometimes 20 inches), with fibrous roots instead of rootstocks, either annual or else perennial by offsets, while the individual flower stalks *(pedicels)* are almost always bracted (instead of bractless). The celebrated Gen. Frederick Funston, U.S.A., who made a botanical expedition of Yakutat and Disenchantment Bays, Alaska, in 1892 reported this plant as very abundant along glacial streams in that area and that it formed, both raw and cooked, an important part of the diet of native Indians. Considered fair to good elk and deer feed in spring and summer; noted sometimes to be nibbled by sheep. Occasionally used by natives and others as a potherb.

3. **Chamisso Indianlettuce [*Montia chamissoi* (Ledebour) Tidestrom,** syns., *M. chamissonis* (Ledeb.) Greene, *Claytonia chamissoi* Ledeb., *Crunocallis chamissonis* (Ledeb.) Rydb.] is a succulent herb perennial by stolons or running rootstocks that bear bulblets at the ends of short branches or in the axils of the root branches. The slender, weak, leafy stems root at the joints where they may touch the ground and are 2 to 13 inches long. The delicate long-stalked flowers vary in color from pale rose or pink to white. The plant occurs in subalpine or cool swamps from Alaska to Minnesota, New Mexico, and California. Palatability very low to fair. Reported to be nibbled sometimes by cattle. It is named for the famous German poet, botanist, and explorer, Adelbert von Chamisso (1781–1838).

4. **Lineleaf Indianlettuce [*Montia linearis* (Dougl.) Greene,** syns. *Claytonia linearis* Dougl., *Montiastrum lineare* (Dougl.) Rydb.] grows in moist places in the mountains from British Columbia to Montana, Nevada, and California. It is a leafy-stemmed annual with fibrous roots; alternate, very narrow leaves, and 1-sided racemes of long-stalked white flowers. It is too local, small and scanty in stand to have any special economic significance, though sometimes cropped a little by livestock in the forepart of the season before it dries up and blows away.

5. **Minerslettuce [*Montia perfoliata* (Donn) Howell,** syns. *Claytonia perfoliata* Donn, *Limnia perfoliata* (Donn) Haw.], an often reddish annual, grows in more or less shaded sites up to the ponderosa pine belt, from British Columbia to the Dakotas, Arizona, and California, and Lower California. It has been reported from Colorado, but that is doubtful. The most characteristic feature of the plant is a pair of stem leaves that are united into a rounded disklike appendage below the inflorescence. Its palatability has been reported as low or negligible. The plant is in common local use as a potherb.

Portulaca *(Portulaca)*

About seven species of portulaca occur on the western range. They are annual or perennial, often succulent and diffusely branched herbs, with opposite or alternate, cylindrical or flattened leaves. The flowers, sometimes brightly colored, have 2 sepals, 4 to 6 petals, 8 to numerous stamens, a partly inferior ovary, and 3 to 8 styles. The fruit is a 1-celled capsule, opening by a horizontal lid *(circumscissile)*, with kidney-shaped seeds. **Common portulaca (*P. grandiflora* Hook.)**, native to southern Brazil and Argentina, is a familiar ornamental annual.

The commonest range species is perhaps **purslane,** or pusley **(*Portulaca oleracea* L.)**, a prostrate-spreading, freely branching succulent annual with a deep central root. The origin of this plant is controversial, but it probably originally was Asiatic. It is now almost cosmopolitan, especially in the warmer parts of both hemispheres. The small yellow flowers open in bright sunshine for a few hours only in the morning; the seeds are finely wrinkled and warty. The plant is a typical ruderal, growing in fields, waste places, along roadsides, etc. It will endure considerable drought and a dry soil but flourishes in the richer, medium moist situations where it may attain very large size.

The forage value of purslane varies greatly with sites and associates. On some of the more southern ranges it is a valuable forage. Thornber *(201)* speaks well of it on summer Arizona ranges. However, Kearney and Peebles *(109)* state that the species is rare in Arizona and it doubtless is frequently confused there with the closely related native **Southwestern purslane (*Portulaca retusa* Engelm.)**, which ranges from Missouri and Arkansas to Oklahoma, Texas, and Arizona, and has notched leaves, blunt (instead of sharp pointed) sepals, 3 or 4 (instead of 5 to 7) styles, and sharp conical projections on the seeds. It is considered good summer cattle feed on the Jornada Experimental Range (southwestern New Mexico).

Bentley *(21)* says that purslane "grows in every county in central Texas and is known locally as 'hog pusley'. * * * It stands dry weather well, and no matter how dry the grasses and other weeds may be its fleshy leaves and stems are abundantly in evidence. There is no doubt as to its value as a forage plant. Hogs will fatten on it and sheep are fond of it. Cattle do not appear to care for it particularly except in the droughty autumn months, when its succulent herbage is greedily sought for." Smith *(182)* states: "This well-known weed is of considerable value as an autumn forage plant in the South and Southwest. The fleshy leaves and stems are put forth in great abundance during the hottest and driest weather and it is hard to kill. The same qualities which make it a vile pest in our gardens and fields cause it to be highly esteemed by sheepherders and cattlemen in years of drought."

Death of both sheep and cattle have been reported to occur in eastern Arizona from bloat due to excessive use of purslane. The

plant is a familiar and often pestiferous weed in gardens and cultivated ground. It is a popular local potherb—to which the scientific name *oleracea* attests—and, in fact, cultivated horticultural varieties of it exist.

Shaggy portulaca (*Portulaca pilosa* L.), sometimes called "jump-up-and-kiss-me," is an annual (sometimes longer lived) with cylindrical leaves with shaggy axils, and small or medium-sized pink or purplish flowers. It ranges chiefly in sandy sites from Georgia and Florida west to Missouri, Texas, and New Mexico, and south into Mexico, the West Indies, Central and South America. It is reported as fairly good sheep feed in southwestern New Mexico.

A somewhat woody species, **shrubby portulaca (*Portulaca suffrutescens* Engelm.)**, with a long woody thickened taproot, slender pale green stems, small leaves, and copper-colored flowers, is found from Arkansas and Texas to Arizona and northern Mexico. Kearney and Peebles *(109)* report it as "Arizona's showiest species" of the genus. It is reported as fair spring cattle feed in southern New Mexico.

Pussypaws *(Spraguea)*

This genus of small to medium-sized rosette plants commemorates Isaac Sprague (1811-95) the well-known Massachusetts botanical artist who collaborated with Asa Gray and companion of Audubon on his 1840 expedition to the Upper Missouri. The inflorescence, roughly resembling a cat's paw, is in dense scorpioid spikes clustered in umbels or heads. The 2 rounded sepals are thin and membranous, persistent and more or less fused; petals 4; stamens 3; styles 2; fruiting capsules 2 valved, with black shiny seeds.

Of about three valid range species, the best-known is **common pussypaws [*Spraguea nmbellata* Torr.**, syns. *Calpytridium nudum* Greene, *S. nuda* (Greene) Howell]. It ranges from Washington and Idaho to the Yellowstone Park region of southwest Montana and northwest Wyoming, to Nevada and California. It is a biennial or sometimes apparently annual or perennial, with a fleshy, somewhat thickened, spindle-shaped taproot; the often reddish stems are from 2 to 12 inches high. The fleshy leaves are mostly in a dense basal rosette, 1 to 4 inches long and spatula shaped. The white or somewhat rose-colored flowers are in an involucred umbrella-shaped cluster.

Common pussypaws usually grows in sandy, gravelly, rocky, or other well-drained sites between elevations of about 3,000 and 10,000 feet. It is often regarded as a good sheep weed. However, California sheepmen have reported that sheep occasionally die from eating its flower heads; the flower heads become cottony and impacted in the sheep's stomach. It is sometimes cultivated as an ornamental for rockeries and edging.

Fameflower *(Talinum)*

Talinum, a name supposedly of aboriginal origin, has about 14 range species; they are perennial herbs or somewhat undershrubby,

often with rootstocks or fleshy roots. The often cylindrical *(terete)* leaves are alternate or nearly opposite. The flowers are from the leaf axils or in terminal cymes, with 2 membranous deciduous sepals; 5 or more soon-withering petals; 3 more or less united styles; 5 or more stamens, and a 1-celled, 3-valved, parchmentlike fruiting capsule containing flattened, shiny, kidney-shaped seeds. Some of the native species, such as the New Mexican ***T. pulchellum* Woot. & Standl.**, are distinctly ornamental and worthy of cultivation.

Orange fameflower (*Talinum aurantiacum* Engelm.), with spreading stems and axillary orange-colored flowers, ranging from western Texas to Arizona, is ordinarily of little or no importance for grazing. One Forest Service employee reported it from southwestern Arizona as a secondary plant for hogs and cattle during the summer months; he added: "It occurs in scattering stands, although thick in swales or lands subject to flooding. Grows to 8 inches high, then falls over, lies along the ground, then spreads out and grows about 3 or 4 inches longer."

Narrowleaf fameflower [*Talinum angustissimum* (A. Gray) Woot. & Standl.] is very closely related to *T. aurantiacum*. It has the same range but is more erect and fleshy, larger and stouter, with narrower leaves, and larger yellow flowers. Bailey *(11)* states that this plant is an important food for jack rabbits and other rodents in desert areas, furnishing them with a needed source of water.

PINK FAMILY (CARYOPHYLLACEAE)

This is a medium large family, which, omitting the whitlowwort family (Illecebraceae, or Corrigiolaceae) united by some botanists with it, is represented in the western range area by about 19 genera and 180 species. It consists of annual or perennial herbs—or some species might be denominated diminutive undershrubs—with opposite leaves (or, in a few cases, whorled or with the uppermost leaves alternate), the leaves often partly united at base; the stems are often swollen at the joints. The flowers have their parts in 5's or 4's, with a persistent calyx, stamens up to 10, and 2 to 5 styles stigmatic on the inner side. The fruit is a capsule.

Because of the attractiveness of the flowers of many species in this family, a large number of them are in ornamental cultivation. This is particularly true of the pink genus *(Dianthus)*—especially **carnation, or clove pink (*D. caryophyllus L.*)** and **sweetwilliam (*D. barbatus L.*)**; also **babysbreath *(Gypsophila paniculata* L.)**. The range importance of the family largely rests on the number and wide distribution of many of these (often small) plants, the palatability of some of them, and the fact that a few species are poisonous.

Common corncockle (*Agrostemma githago* L.), a winter annual or biennial native to the Old World is now widely naturalized in the United States and Canada, especially in the more northern parts of the former and the more southern parts of the latter. Be-

cause of the difficulty of screening the seeds from wheat, it is especially prevalent in wheat and other grainfields and from that source has invaded roadsides, abandoned fields, and the like.

The stems of common corncockle are 1 to 3½ feet tall, with opposite narrow leaves 2 to 4 inches long, terminal solitary long-stalked flowers of greatly varying size, the calyx with a well-marked tube and 5 long lobes or teeth two or three times longer than the tube; 5 purple, red or sometimes white petals; 10 stamens, and 5 styles alternating with the calyx lobes. The seeds are numerous, rough, rather large and black. While hardly attractive to grazing livestock, the plants are occasionally observed to be nibbled and apparently with impunity.

The chief economic interest in the plant is the seeds which are reported to cause annual losses of millions of dollars to wheat-growers. Wheat flour containing significant amounts of corncockle seed is unfit for human consumption and dangerous. The seeds contain a saponin (substance causing sudsy froth in water) named *githagin,* and probably toxic alkaloids as well. They are highly poisonous to chickens, ducks, and geese, *(123, 141, 151).*

Sandwort *(Arenaria,* syn. *Alsinopsis)*

The genus *Arenaria*[19] is represented in the western range area by about 44 species. Sandworts are small, mostly tufted perennial or sometimes annual herbs, with opposite stalkless slender leaves; small, usually white flowers borne in open or contracted terminal clusters *(cymosely* or *capitate)* or rarely solitary in the leaf axils. There are 5 sepals and 5 (rarely absent) untoothed or apex-notched petals; usually 3 (2 to 5) styles opposite the sepals; 10 stamens; a rounded or oblong fruiting capsule opening by valves or teeth as many or twice as many as the styles, and numerous small seeds. Some of the species when not in flower suggest, with their dense clusters of fine leaves, colonies of pine seedlings. Some botanists prefer to place those species with three-toothed capsules in a separate genus, *Minuartia.*

Sandworts, widely distributed throughout the West, are most common on rather dry, sandy, or gravelly soils but are also found on moderately moist, rich loams. Common on the western ranges, they occur from the plains and foothills to well above timberline in the mountains but, as a rule, are scattered among other plants and not abundant in any one place. As a class, they average from poor to fair in palatability for all classes of livestock, although in Utah, Nevada, southern Idaho, California, and the Northwest they are generally considered from practically worthless to, at best, poor forage. The palatability of the sandworts undoubtedly varies

[19]The generic name is derived from the Latin *arenarius* (belonging to sand) and refers to the characteristic habitat of many of the species. The Latin word *arena* means sand, or figuratively, since the Romans sprinkled sand on the fields used for gladiatorial contests to absorb the blood, the word came to mean any place of combat. The common name, sandwort, also implies a plant or weed of sandy places, wort being a Middle English word (Anglo-Saxon *wyrt*) meaning herb.

not only for the different species but also for the same species in different localities and at different times of the year. In general, the palatability is highest in spring and in localities where the plants are most abundant.

Prickly sandwort (***Arenaria aculeata*** **S. Wats.**) ranges in scablands and dry sandy or gravelly sites from middle to high elevations (up to about 9,000 feet in Arizona), from northeastern Oregon and Idaho to Utah, northwestern New Mexico, central Arizona, Nevada, and California (east of the Sierra Nevada). It is a loosely or somewhat densely matted perennial, more or less glandular-hairy above, often with woody crown and roots; rather slim flowering stems 4 to 8 inches high; fine, stiff, rigid, prickletipped leaves somewhat bluish when young, spreading and darker in age; the shallowly notched petals are about half again as long as the sepals and, at maturity, the fruiting capsules are about twice as long as the sepals. As a rule this plant is negligible for forage but in some places it has been observed to be limitedly grazed by sheep.

Closely related to prickly sandwort is **Uinta sandwort** [***Arenaria uintahensis*** **A. Nels.**, syn. *A. aculeata* var. *uintahensis* (A. Nels.) Peck]. It differs chiefly in that it is smoother and less glandular than prickly sandwort, and has softer, less rigid and non-prickletipped foliage, and fruit hardly longer than the persistent sepals. Its range is from southeastern Oregon, Idaho, and western Montana south to Colorado and Utah. Its forage value is, as a rule, worthless or low.

Ballhead sandwort (***Arenaria congesta*** **Nutt.**) (fig. 28) is distributed, chiefly in the mountains, from eastern Washington to Montana and south to Colorado and central California, occurring mostly between about 5,000 and 10,000 feet, although sometimes found at both lower and higher altitudes. It grows on a wide variety of soils from deep, rich, moist loams to dry gravels, in grass, weed, sagebrush, aspen, ponderosa pine, lodgepole pine, and other vegetal types. Although a common plant on many western ranges, it is not, as a rule, locally abundant but usually occurs scatteringly in mixture with other plants.

The light-green, narrow, rigid leaves are produced mostly at the base, while the stems bear two to four pairs of leaves rather distantly spaced, the uppermost pair being much smaller than the others. The flowers typically are congested into (mostly terminal) headlike clusters subtended by small, papery-margined bracts. The five sepals are thin, dry and papery except for the prominent midvein and are conspicuously shorter than the petals. A form with woody crown and roots and a more open inflorescence has been described as ***Arenaria congesta*** var. ***suffrutescens*** **Robinson.**

The palatability of ballhead sandwort varies considerably, especially in different localities and with the season of the year, and appears to be highest in those localities where it occurs most abundantly. In Montana, while the growth is young and tender, the general palatability of this species is fairly good for cattle and good for sheep; in Wyoming and Colorado it is fairly good for cattle but only fair for sheep; in the Southwest, only fair for both

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FIGURE 28.—Ballhead sandwort (*Arenairia congesta* Nutt.).

classes of livestock; in California and the Northwest, poor for sheep and practically worthless for cattle; and, in Utah, southern Idaho, and Nevada, it is usually worthless. It has been observed to be grazed by mountain sheep at high elevations on the Routt National Forest (Colorado), and by elk in winter on the Teton National Forest (Wyoming).

Very close botanically to ballhead sandwort is **Burke sandwort** [***Arenaria burkei* Howell,** syns. *A. congesta* var. *subcongesta* S. Wats., *A. fendleri* var. *subcongesta* S. Wats., *A. subcongesta* (S.

Wats.) Rydb. and, probably, *A. glabrescens* (S. Wats.) Piper].[20] It has a wider range than *A. congesta*—from southern British Columbia and Alberta to Montana, western Colorado (doubtfully in New Mexico), Arizona, and California. It is likely that reports of *A. congesta* from Arizona, Alberta, and British Columbia actually refer to *A. burkei.*

The several or tufted stems of *Arenaria burkei,* 4 to 10 inches high, come from a more or less woody crown and root. This species chiefly differs from *A. congesta* in the almost stalkless flowers occurring in small clusters *(glomerules)* at the ends of the inflorescence branches in an umbellike arrangement and in the sharp-tipped or tapered sepals that are almost as long as the fruiting capsules. It occurs in rather dry sites between elevations of about 4,000 and 7,500 feet. Its forage value is as variable as that of *A. congesta,* depending on location, abundance, associates, etc.; generally it varies from worthless to poor but its palatability has been rated as fair to good for different kinds of livestock on certain national-forest areas in Montana.

Fendler sandwort (*Arenaria fendleri* A. Gray)[21] is a tufted but usually not densely matted perennial, the slim stems 4 to 8 inches high; the inflorescence is open, more or less glandular-hairy; the petals are only slightly longer than the sepals. The fine basal leaves, sometimes 4 inches long, often have a grasslike appearance. This species occurs in aspen and spruce types to above timberline at alpine elevations and has been collected as a pygmy undershrub at 12,000 feet on San Francisco Peaks, Ariz. It is one of the more palatable members of the genus, although frequently regarded as worthless to poor as forage.

Somewhat closely related to Fendler sandwort is **fescue sandwort [*Arenaria formosa Fisch.*,** syn. *"A. capillaris"* of U.S. authors, not Poir.]—so-called because some people think it resembles a small, fine-leaved fescue *(formosa,* "pretty," refers to the rather attractive little flowers). Fescue sandwort ranges in alpine meadows and other higher elevations from British Columbia and Alberta to western Montana, northern and western Wyoming, Utah, Nevada, and California. It apparently is absent from Colorado and Arizona. As indicated, this is the *A. capillaris* Poir. of some of our manuals, but that species was described from Siberia and should probably be considered distinct from our west-American one.

The slim erect stems, 3 to 12 inches high, are usually several or tufted from a creeping rootstock or with somewhat woody crown branches. The almost threadlike leaves, ½ to 3 inches long, are rather soft and usually not pungent, or sharp tipped. The flowers are few, white, in open, flat-topped clusters, the sepals minutely glandular-hairy, broadly oval and blunt tipped, about half as long

[20]The species commemorates Joseph Burke, A British naturalist and collector who in 1844–46 explored the Rocky Mountains, the Snake River country in Idaho, and the Toiyabe Mountains of Nevada.

[21]One of the numerous plants that commemorate Augustus Fendler (1813–83), German-American botanical collector who was with the United States troops who took Sanda Fe, N. Mex., in 1846, and some of whose Southwestern collections were the basis for Asa Gray's book Plantae Fendlerianae.

as the petals. Ordinarily this plant is negligible or poor as forage.

The following two sandworts are small, common, often densely tufted, arctic-alpine plants of practically no forage significance:

1. **Nuttall sandwort (*Arenaria nuttallii* Pax)**, ranging from southeastern British Columbia and southern Alberta to southwestern Idaho, Utah, Nevada, and northern California. Found on dry rocky slopes near snow on the highest peaks above timberline, with long runners or sometimes a woody taproot, the herbage glandular-hairy throughout; leaves crowded, somewhat awllike, numerous, crowded, often spreading, ¼ to ½ inch long, the petals shorter than the strongly tapered, 1-nerved (or sometimes indistinctly 3-nerved) sepals, which are longer than the fruiting capsules. Occasionally observed nibbled by sheep and goats. The species is named for Thomas Nuttall (1786–1859), well-known British-American naturalist and explorer of the West.

2. **Siberian sandwort (*Arenaria sajanensis* Willd.)**[22] originally known from the Saiansk Mountains, southwest of Lake Baikal, Siberia, with about the same American range as Nuttall sandwort but occurring farther south into New Mexico, Arizona, and the Sierra Nevada of California and farther east into western Montana and Colorado. It differs from Nuttall sandwort in often being more prostrate-trailing and mosslike, the stems a bit more slender, less than ½ to 2½ inches high, the oblong sepals *rounded* at the tip, distinctly *3 nerved*, and much *shorter* than the petals.

Closely related to the genus *Arenaria* and by some conservative botanists regarded as subgenera or sections of it are *Honkenya* and *Moehringia*.

Sea-purslane [*Honkenya peploides* (L.) Ehrh., syns. *Ammodenia peploides* L., *Arenaria peploides* (L.) A. Gray] is a succulent maritime plant inhabiting sea beaches and dunes on both sides of the Atlantic and in northern areas of the Eastern Hemisphere. Because of its variability a number of varieties and subspecies and even species of it have been proposed and some authors prefer to put our Pacific plant, ranging from Alaska to California into a distinct species *H. oblongifolia* Torr. & Gray [syns. *Ammodenia oblongifolia* (Torr. & Gray) Rydb., *H. peploides* var. *oblongifolia* (Torr. & Gray) Wight]. Gleason *(81)* says the northeastern plant is ssp. *robusta* (Fernald) Hultén of *H. peploides*, while Abrams' *(2, v. 2)* lists this plant under the name *H. peploides* var. *major* Hook. The genus commemorates Gerhart August Honckeny (1724–1805), a German botanist.

The plant is locally very common, forming dense clumps, the stems often purplish at the top. It is perennial from stolons, with opposite thick somewhat clasping elliptic, oblong, obovate, or ovate-lance-shaped leaves; the flowers have a conspicuous 8- to 10-lobed disk, a distinctive feature of the genus. Fernald and

[22]The nomenclature of this plant is in controversy. Some botanists restrict *sajanensis* to Siberia and call our American plant *A. obtusiloba* (Rydb.) Fernald. Rydberg (*172*) recorded that American "*sajanensis*" is composed of *Arenaria laricifolia* L., *A. marcescens* Rydb., and *Alsinopsis obtusiloba* Rydb. [syns. *Arenaria obtusa* Torr. (1827) not All. (1785), *Arenaria biflora* S. Wats. (1878) not L. 1767)].

Kinsey *(70)* mention that the plant is sometimes made into pickles and used as a salad plant or potherb, and is made into a beverage in Iceland. Perhaps the species should not be listed as a range plant but its salty taste attracts livestock and other herbivorous animals and Fernald and Kinsey cite Harold St. John to the effect that it is "the choicest fodder * * * of wild ponies" roaming Sable Island off the coast of Nova Scotia.

There are two range species of **moehringia** (***Moehringia***), delicate, slender-stemmed, sometimes almost vinelike herbs perennial from slender rootstocks, and small white flowers solitary or in few-flowered clusters. The habit is different from that of the typically densely tufted sandworts, the leaves are broader and larger, the fruiting capsules have only a few seeds and these possess a broad papery growth *(strophiole)* around the hilum. The genus commemorates Paul Heinrich Gerhard Moehring, an 18th century botanist of Danzig, Germany.

Bluntleaf moehringia [***Moehringia lateriflora*** **(L.) Fenzl,** syn. *Arenaria lateriflora* L.] has oblong-oval, blunt-tipped leaves and nontapered sepals, the valves of the fruit 2 cleft. It is found in moist, often shaded sites from Alaska to Oregon, in the interior mountains to Utah and New Mexico and east to Missouri, Pennsylvania and New Jersey, Newfoundland, and Labrador; also in northern Europe and Asia. **Longleaf moehringia** [***M. macrophylla*** **(Hook.) Torr.,** syn. *Arenaria macrophylla* Hook.] ranges in similar sites from Labrador and Quebec to British Columbia, south to the Sierra Nevada of California, New Mexico, Minnesota, New York, and New England. It has lance-shaped to linear-lance-shaped, tapering leaves, narrower and somewhat longer than those of *M. lateriflora,* tapered sepals and somewhat angled stems. The forage value of these plants varies from worthless to fair, depending on local conditions. It is more palatable to sheep and goats than to horses and cattle and, when grazed at all, chiefly in spring and early summer. These species are seldom abundant in any one place, and their palatability and amount of herbage are insufficient to make the plants important.

Cerastium *(Cerastium)*

A genus of more or less hairy and sometimes sticky annual or perennial herbs, with opposite stipule-less leaves, and white flowers with 5 sepals, 5 petals (mostly notched or 2 cleft at the tip), usually 10 stamens, and 5 (occasionally only 3 or 4) styles. There are perhaps as many as 20 range species, the number depending on the viewpoint of the individual botanist. Linnaeus appears to have derived the generic name from Greek κεραστις (horned serpent) reflected in the generic name *Cerastes* for the horned vipers of the Old World. The name *Cerastium,* therefore, alludes to the peculiar fruiting capsules of the genus, which are cylindric, thin, and usually with a curved, somewhat hornlike tip opening by 10 short teeth.

A few species are in ornamental cultivation for rockeries and edging, such as **snow-in-summer** ***(Cerastium tomentosum*** **L.).** Mem-

bers of this genus are often called "chickweed" [a name better restricted to *Stellaria media* (L.) Cirillo] "mouse-ear," "mouse-ear chickweed," and "powderhorn." Probably the commonest range species are: **starry cerastium** (*C. arvense* **L.**), **Bering cerastium** (*C. beeringianum* **Cham. & Schlecht.**), **plains cerastium** (*C. campestre* **Greene**), **nodding cerastium** (*C. nutans* **Raf.**), **Rocky Mountain cerastium** (*C. scopulorum* **Greene**), **common cerastium** (*C. strictum* **L.**), and **sticky cerastium** (*C. viscosum* **L.**). However, some botanists regard *C. campestre* and *C. scopulorum* as being mere forms or variations of *C. arvense* and others think that typical *C. strictum* should be confined to the Old World or at least that United States material so called is also referable to forms of *C. arvense*.

Cerastiums vary in palatability from worthless or low to occasionally fair or even fairly good, especially for sheep and goats, depending on abundance and presence or absence of more palatable associates. They are, in the main, small plants, producing only a limited amount of herbage. Starry cerastium is reasonably typical of the genus as a whole.

Starry cerastium (*Cerastium arvense* **L.**) occurs in fields and, in the mountains, in valleys and also dry rocky places up to timberline, ranging from Labrador to Alaska and south to California, northern Arizona and New Mexico, Missouri, and Georgia; also in Europe and Asia. It is a tufted perennial, the stems erect or ascending, 4 to 12 inches high, the base often matted and leafy, with slender and often somewhat woody rootstocks. The leaves are narrow, linear or linear lance shaped, and sharp pointed; often there are clusters of leaves in the lower leaf axils. The white flowers are in terminal clusters, rather numerous, appearing April to July, the petals twice as long as the sepals. In bloom the plant is rather showy and is sometimes cultivated as an ornamental. It is grazed moderately by sheep in some areas but is considered worthless in others.

Deptford pink (*Dianthus armeria* **L.**), sometimes called "grass pink," a native of Europe, widely naturalized in the United States, is the only range species of this genus, which is famous for the number of its cultivated species, especially the **carnation**, or **clove pink** (*D. caryophyllus* **L.**). Deptford pink is an erect, fine-hairy annual 6 to 18 inches high, with opposite linear erect or ascending leaves, and small pink, light-spotted flowers solitary or in terminal few-flowered clusters; the cylindrical calyx has a distinct tubular base, 5 toothed at the tip; there are 2 styles. The plant is of no forage importance. Rather closely related botanically to *Dianthus* are three other genera (*Saponaria, Vaccaria,* and *Velezia*), species of which, introduced from the Old World, have become local members of the western range flora.

Bouncingbet (*Saponaria officinalis* **L.**) perhaps has escaped from old-fashioned gardens. It is a smooth stout erect perennial herb, about 1 to 2 feet high, with opposite lance-shaped to oval leaves, and dense terminal clusters of showy rose-colored flowers, and is often locally common along roadsides or in old fields. The whole plant, especially the roots, contains the glucoside *saponin*,

which makes a froth in water and, taken internally, may cause inflammation of the digestive tract and destruction of the red corpuscles of the blood *(123)*. There is little, if any, evidence of this plant's being grazed by domestic livestock and no case of poisoning of range animals appears to be known; however, it may be a potential source of poisoning. Pammel *(151)* reports that the seeds are supposed to be poisonous when they occur in wheat screenings. The plant has locally been used as a soap substitute and Pammel *(151)* indicates that it is effective in removing grease spots from wool.

Cowcockle, sometimes called cowherb and cow soapwort [***Vaccaria segetalis*** **(Neck.) Garcke,** syns. *Saponaria vaccaria* L., *V. vaccaria* (L.) Britton, *V. vulgaris* Host], introduced—chiefly as a weed in and about grainfields—is a smooth, somewhat bluish annual with erect forking stems 1 to 3 feet high, with oval or lance-shaped leaves clasping at the base, and pale red or pink flowers about ½ to 1 inch across in loose erect clusters; there are 10 stamens and 2 styles. Each of the rounded fruiting capsules contains about 20 round, hard, dark-colored seeds somewhat resembling small shot. Some botanists prefer to place the plant in the soapwort genus *(Saponaria)* but there are a number of differences, including the flask-shaped, strongly 5-angled (winged in fruit) calyx and the lack of appendages at the base of the petals (found in *Saponaria)*.

The name *Vaccaria,* derived from Latin *vacca* (cow), is supposed to indicate a fondness for it by cattle. However, the plant is not known to have poisoned animals under range conditions. The seeds contain *saponin.* Chesnut and Wilcox *(37)* speak of the plant being a noxious weed in Montana grainfields and that, because of its occurrence in spring wheat, it is often called "spring cockle"; that chickens and horses reject screenings containing cowcockle seed but hogs and sheep will eat it, and that sickness or death can be induced in rabbits by forced feeding with the seeds.

Stiff velezia (*Velezia rigida* L.), introduced from the Mediterranean region in dry California foothills, is a bushy little annual, rigidly branched from the base, 4 to 16 inches high, with small awllike leaves, and small narrow flowers, the calyx tube and fruiting capsules narrowly cylindrical, the petals long clawed and with small blades. Of no value for forage. The genus commemorates Cristobal Velez, a Spanish colleague of the 18th century Swedish botanist, Peter Loefling.

Drymary *(Drymaria)*

There are about six range species of this chiefly Mexican genus, sometimes locally called "seccomaria." They are small bushy-branched annuals, with slender stems, opposite or whorled leaves, and small white or whitish flowers. There are typically 5 (sometimes fewer) sepals and petals, the petals deeply lobed or divided, 1 style and usually 5 stamens. The fruit is a small capsule splitting when ripe by three valves. The genus is greatly in need of competent monographing. Thus far only one species has assumed any

range significance. It might be worth noting in this connection that Dickson *(59)* stated that *Drymaria cordata* on a tea estate in Uva, Ceylon, was encouraged as a ground cover to prevent erosion and had a very favorable effect for 3 or 4 years; after that it became too aggressive, diminished the tea yield about 100 pounds per acre, and had to be eradicated.

Thickleaf drymary *(Drymaria pachyphylla* Woot. & Standl.) (fig. 29) is often referred to *D. holosteoides* Benth., which is typically a

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FIGURE 29.—Thickleaf drymary (*Drymaria pachyphylla* Woot. & Standl.).

seashore plant growing on beaches of Lower California and of the western coast of Sonora. Brandegee *(30)* says that "*D. holosteoides* is annual, low, usually prostrate-spreading, somewhat glaucous, pubescent; leaves ovate, cuneate at base, thickish; pedicels scarcely equalling the leaves." He further indicates that *D. crassifolia* Benth., a more rounded, more bluish and perfectly smooth plant with thicker leaves and longer flower stalks is frequently confused with *D. holosteoides*. Little *(120)* although (at least temporarily) holding *D. pachyphylla* to be a synonym of *D. holosteoides*, states that the latter has "much narrower, acutish leaves, puberulent pedicels, and slightly smaller seeds."

Thickleaf drymary ranges, in dry adobe soils at low elevations, from southwest Texas to southern New Mexico and southeastern Arizona and south into Coahuila and Chihuahua. The herbage is smooth and bluish white *(glaucous)*; the leaf blades are thickish, ovate, rhombic or broadly elliptic and blunt tipped; the flowers are in stalkless or nearly stalkless clusters from the leaf axils, the sepals ovate and blunt or slightly pointed *(apiculate)*. A distinc-

tive feature of the plant is the purplish juice emanating from the green capsules and unripe seeds when squeezed between the fingers. In dry weather the plant may be prostrate but may rise up after a light shower. The species is a prolific seeder; Little *(120)* reports that a plant 4 inches in diameter may mature 250 capsules containing about 3,750 seeds.

While thickleaf drymary is small, short lived, and unpalatable it is aggressive and, when good feed is unavailable, it is exceedingly dangerous and has caused heavy losses of cattle and, in some cases, of sheep and goats. The poisonous principle, still unknown, is virulent, death often taking place in a few hours, nervousness and bloody discharges being among the symptoms. Ares *(7)* reports that hoeing of this plant by local stockmen on the Jornada Experimental Range (southwestern New Mexico) reduced cattle losses from 91 in the period 1926–33 to 10 in the period 1934–40. This pioneer plant, according to one Forest Service employee on the Jornada "represents practically the only early weed stage on clay soils denuded by trampling or erosion, and any measure for its permanent control must be based upon the reestablishment of a higher stage in the series, either by natural revegetation, or by artificial reseeding of pioneer grasses." There is now considerable literature for this species, e.g.: Mann *(128)*, Lantow *(115)*, Mathews *(137)*, and Little *(119, 120)*.

Holosteum (*Holosteum umbellatum* L.) is a small tufted annual, 3 to 10 inches high, glandular-hairy above and slightly woolly below, native to Europe and Asia and naturalized in this country, especially in the Atlantic and Pacific coast States. The oblong leaves are up to about ¾ inch long, the small flowers in a 3- to 8-flowered umbel, the individual flower stalks *(pedicels)* bent down *(reflexed)*, the 5 petals with jagged-toothed *(erose)* margins—whence one of the common names, "jagged chickweed"; styles 3. The fruiting capsules are ovoid cylindrical with 6 recurved teeth at the tip. It is sometimes nibbled by sheep but is hardly abundant or large enough to have any particular range significance. The name is derived from Greek *holosteon* (meaning "all bone"), a plant name used by Dioscorides and, perhaps, was facetiously transferred to this delicate plant by Dillenius and Linnaeus.

Rather closely related to *Holosteum* is the **pearlwort** genus *(Sagina)*, represented in the range area by about six species. Perhaps the commonest and most widespread of these is **arctic pearlwort [*S. saginoides* (L.) Britton**, syn. *S. linnaei* Presl], in the arctic regions of both hemispheres, in northern Michigan, and, in the West, from Alberta and British Columbia to California, (on the highest peaks of) Arizona and New Mexico, Utah, Colorado, and Montana. It is a high-range, small, tufted perennial, 1 to 4 inches high, with small linear leaves less than ½ inch long, 5 petals shorter than the sepals, 5 styles alternating with the sepals and of about the same length, and ovoid-oblong fruiting capsules splitting to the base by 5 valves. Forage value, negligible or low. Western United States plants of this species are often referred to var. ***hesperia* Fernald.**

Three related genera of very minor range significance are *Loeflingia, Spergula,* and *Spergularia.* **Loeflingia *(Loeflingia)***, named for Peter Loefling, an 18th century Swedish naturalist, is represented in the West by a Texas, a Tehachapi Mountains (California) species and by ***L. squarrosa* Nutt.**, an almost prickly, diffuse little annual, 1 to 3 inches high, found in "desert" areas of California and Arizona; it appears to have no forage value but probably does local service as ground cover. Loeflingias are all small annuals, with narrow awllike leaves with stipules, greenish flowers with 3 stigmas, the styles small or lacking.

Allseed *(Polycarpon)*, also called "polycarp" and "manyseed," is a genus of bushy little annuals with flat leaves, thin stipules, and clusters of numerous small flowers with 5 sepals, 5 petals shorter than the sepals, 3 to 5 stamens, and 3 styles united below. There are 2 species of this genus in California: **California allseed (*P. depressum* Nutt.)**, a very diminutive plant growing at lower elevations from central California to Lower California, and **fourleaf allseed (*P. tetraphyllum* L.)**, with leaves often in 4's, naturalized from Europe and growing in waste places. These plants are not known to have any forage value.

Corn spurry (*Spergula arvensis* L.) is widely distributed in the United States as a weed from Europe. It is an annual, 6 to 18 inches high, with linear somewhat fleshy, *whorled* leaves—or perhaps the leaves truly opposite but appearing whorled because of others fascicled in their axils and of about the same size, 1 to 2 inches long. Sepals and white petals, 5; stamens usually 10; styles and capsule valves *usually 5*. It has been reported as somewhat trailing and abundant along beaches of the Tongass National Forest, Alaska. Probably unimportant as a forage plant but more data are desired.

Sandspurry *(Spergularia,* syn. *Tissa)* is represented in the western range area by about 11 species. *Spergularia* is a conserved name under the International Code. The species are low annual or perennial, mostly fleshy herbs, often growing in saline or alkaline sites; the leaves are opposite but often with smaller leaves fascicled in their axils; there are 5 sepals and petals, 2 to 10 stamens, the styles and capsule valves *usually 3*. **Red sandspurry [*S. rubra* (L.) J. & C. Presl,** syn. *Tissa rubra* (L.) Britton] is a common, branching annual or short-lived perennial with prostrate or ascending stems 2 to 12 inches long, the pink petals shorter than the sepals, and widely distributed in sandy or gravelly sites in the Eastern and Western Hemispheres; it is native to Europe. As a rule it is worthless as forage but occasionally has a little value for sheep.

Campion *(Lychnis)*

Many members of this genus are in ornamental cultivation; about 10 species occur on western ranges. They are biennial or perennial herbs, mostly with rather showy flowers. The sepals are united into an often more or less inflated tube; petals 5 with entire, 2-cleft or slash-toothed *(laciniate)* blades, the 5 (rarely 4)

styles alternating with the petals; stamens, 10. In Rydberg's Flora of the Rocky Mountains and Adjacent Plains *(173)* this genus appears under the name *Wahlbergella,* and in a later work *(174)* he accepts *Melandrium* and *Wahlbergella* as well as *Lychnis,* the first two genera named apparently being absent from all our other western botanical manuals. Porsild *(161)* writing about flora of the continental northwest territories of Canada has a section headed "Melandrium *(Wahlbergella),*" in which he indicates that *Wahlbergella* is a synonym of *Melandrium* and somewhat apologetically states that this group has "admittedly slight distinguishing features" from *Lychnis.*

Perhaps the commonest and best known range species of the genus is **Drummond campion [*Lychnis drummondii* (Hook.) S. Wats.,** syn. *Wahlbergella drummondii* (Hook.) Rydb.], found on dry hills, plains and mountain slopes and valleys from British Columbia to eastern Oregon, Nevada, Utah, Arizona, and New Mexico, and north to Manitoba; also found sparingly in Minnesota, Michigan, and Nebraska (naturalized?). It is a perennial herb, 6 to 24 inches high, with a thick rootstock; reverse lance-shaped leaves with the narrow end downwards, and white, pink or purple flowers about ½ inch long. Observations on national-forest ranges do not indicate that livestock find this plant palatable. The species commemorates its discoverer, Thomas Drummond (1780–1835), Scotch-Irish naturalist, nurseryman, and botanical explorer of the arctic and western Canada. Pammel *(151)* reports that *lychnidin,* a presumably toxic saponinlike compound, has been found in the familiar **ragged-robin *(L. floscuculi* L.)** of the gardens.

Silene *(Silene)*

Silene is a genus of annual or perennial herbs, a considerable number of which are in ornamental cultivation in rock gardens, etc. Some species with sticky glands are called "catchfly." "Campion" and "pink," names better referable to the genera *Lychnis* and *Dianthus,* respectively, are also used for this genus. The mostly white, pink, red or purplish flowers are usually in clusters *(cymes),* the calyx united into a *10-many-nerved,* cylindrical, egg-shaped or bell-shaped tube, 5 toothed or cleft at the tip; the 5 petals are clawed at the base, the blades often cleft or toothed and usually with a scalelike appendage at the base; styles 3 (rarely 4 or 5); fruiting capsules opening by 3 or 6 valves.

There are about 42 western range species. The significance of the name silene is in dispute. The name was used by Linnaeus and by at least two of his contemporaries, Royen and Dalibard, but its significance is unexplained by them. Some authorities derive it from *Silenus,* the mythological father of the satyrs; others associate the word with Greek *sialon,* saliva, because of the slimy excretion of some species. At least eight species are of sufficiently wide distribution and abundance to merit short reference.

Moss silene or "moss campion" **(*Silene acaulis* L.)** occurs in the arctic regions of both hemispheres and on the highest mountain peaks in the United States; in the east, only on Mt. Washington,

New Hampshire, and, in Arizona, only on the San Francisco Peaks. It is a small, densely tufted, almost mosslike perennial with a woody crown and root; short linear leaves, and attractive pinkish or purplish (rarely white) flowers solitary and terminal on very short stems. It is a typical alpine plant, growing above timberline in rock crevices, carpeting cliffs and ledges, along wet glacial moraines, and the like. It is in commercial cultivation as a rock-garden plant.

An excellent illustration of a flowering mat of this species can be found in Plant Physiology and Ecology, *(42, p. 98)*. Also, there is an illustrated article about it under the heading "The Cushion Pink" in the American Botanist [25(1). Feb. 1919]. This diminutive plant can hardly be considered as forage and yet sheep and goats nibble on it a bit in summer, and on some high summer ranges on at least two Colorado national forests it is considered fairly palatable for sheep. Fernald and Kinsey *(70)* remark that the "Tough, closely forking stems and masses of persistent dead leaves * * * hardly suggest culinary possibilities. Nevertheless, * * * Sir William Hooker states that the plant is 'boiled and eaten with butter by the Icelanders.' "

Sleepy silene or sleepy catchfly *(**Silene antirrhina** L.)*, with an almost continental distribution, ranges from Newfoundland and Quebec south to California and Florida and, farther south, into Mexico. It is an annual, smooth or minutely hairy herb, farther south, into Mexico. It is an annual, smooth or minutely hairy herb, with slender erect or ascending stems 8 to 20 (rarely 30) inches high. About the stem joints *(nodes)* and especially below the upper ones are bands of gumminess in which grains of dirt, hairs, small insects, and seeds become fastened. The narrow leaves are opposite, the lowest narrowly spatula or reverse lance shaped, the uppermost ones awllike. The flowers are in a loose forking cluster, the small pink petals (sometimes wanting) folded, or "sleepy" for most of the day, opening only for a short time in sunshine.

The plant occurs in dry open sites, sandy fields, waste places, open gravelly woods, etc. Occasionally it is a weed in cultivated ground. In Colorado, according to Rydberg *(171)*, between elevations of 5,000 and 6,000 feet. On western national forests chiefly in the woodland and ponderosa pine belts. The forage value of this plant seems to be negligible or slight. Chesnut *(37)* remarks that this plant is "stated to have poisoned sheep in southern Michigan a few years ago, but there is reason to believe that the poisoning was due to another source." Perhaps it was on this basis that Pammel *(151)* lists it as "said to be poisonous." There appears to be no scientific basis for this supposition.

Douglas silene (***Silene douglasii* Hook.**), a species dedicated to its discoverer, David Douglas (1799–1834), the eponym of Douglas-fir, occurs in grass types and in open aspen, spruce, and ponderosa pine stands, from British Columbia and Alberta to Montana, Utah, Nevada, and California. It is a many-stemmed herb, finely crisp-hairy and sometimes a little glandular above, perennial from a woody taproot. The narrowly reverse lance-shaped to narrowly

linear leaves are up to 2 or 3 inches long. The white or pink flowers are in small open clusters; the calyx, oblong obovoid and scarcely inflated, is about ½ inch long, green nerved, more or less fine-hairy, with blunt teeth; the petals, ⅜ to 1 inch long, have entire blades except for the 2-cleft tips, the egg-shaped fruiting capsules have a short *stipe*, or stalklike base.

Silene multicaulis Nutt. is probably at most not more than a variety [***S. douglasii* var. *multicaulis* (Nutt.) Robinson**] of this species, with larger flowers and better developed upper leaves. Reports of its having greater viscidity and inflated, purple-veined calyces are probably due to some confusion with the related **Lyall silene (*S. lyallii* S. Wats.)**. The forage value of Douglas silene varies with location, vegetal composition and other factors. Frequently it is regarded as worthless.

Ingram silene (*Silene ingramii* Tidestr. & Dayt.) (fig. 30). perhaps the handsomest of the western silenes, native to the Umpqua National Forest area (southwest Oregon) has a certain melancholy interest as its discoverer, Douglas C. Ingram (1882–1929), distinguished forest officer of the United States Forest Service Pacific Northwest Region, perished in the Camas Creek Fire on the old Chelan (now Okanogan) National Forest, Washington, possibly on the very day that the species was published (Biolog. Soc. Wash. Proc. 42:207–208, illus. Aug. 17, 1929.

Abrams *(2)* and Hitchcock and Maguire *(97)* have categorically remanded this species to synonymy under **Hooker silene *(Silene hookeri* Nutt.)**, but Bailey *(10)* and Peck *(155)* recognize it as distinct, because it is taller, with somewhat narrower leaves, distinctly tapered calyx lobes, a longer-stiped ovary, and darker (violet to purple) 4-lobed petals. It is in ornamental cultivation as a rock-garden plant, where it is generally considered distinct from Hooker silene *(11, 41, 76)*.

Mexican silene (*Silene laciniata* Cav.), also known as "fringed Indian pink," "Mexican campion," and "yerba del India," is a Mexican species ranging north into the Southwestern United States from extreme western Texas to New Mexico, Arizona, southern Utah and Nevada, to California south of the mouth of the Sacramento River, and into Baja California. It is a downy erect herb 1 to 3 feet tall, perennial from a woody crown and taproot; the opposite leaves vary in outline from linear lance shaped to reverse lance shaped *(oblanceolate)*, or narrowly oval. The showy crimson or bright scarlet flowers are in a more or less spreading cluster, the cylindrical calyx about ⅝ inch long, the 4 or 5 petals much exceeding the calyx, their blades deeply cleft into about 4 linear lobes and these lobes sometimes, in turn, 2 cleft giving a somewhat fringed appearance.

Further information on the palatability of this plant is desired; in general it seems not to be grazed. Southwestern persons of Spanish descent are reported to use this plant as a kind of tea and the leaves are locally considered useful in the treatment of sores, ulcers, sprains, etc. The species is in ornamental cultivation. Kear-

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FIGURE 30.—Ingram silene (*Silene ingramii* Tidestr. & Dayt.).

ney and Peebles *(109)* call it "Arizona's showiest species of *Silene*."

Menzies silene (*Silene menziesii* Hook.), ranging from Vancouver Island and southern British Columbia to Saskatchewan and south to western Nebraska, New Mexico, and California, has been reported also from southern Missouri. It is a slender, leafy-stemmed plant, perennial from slender rootstocks, the habit superficially resembling that of *Moehringia macrophylla* (Hook.) Torr., but, of course, with a very different floral structure. The often rather weak and decumbent or spreading but sometimes ascending or even erect stems are 3 to 12 inches long, the herbage more or less finely glandular-hairy, especially above, the pubescence having a tendency to point downwards or backwards.

The stemless (or practically so) opposite leaves vary from ovate lance shaped to oblong elliptic or linear lance shaped, up to 3 inches long, and mostly taper at both ends. The inflorescence is leafy, the plant forking above, the white flowers borne on slender stalks from the upper leaf axils; they are less than ½ inch long, the 5 petals 2 cleft or lobed at the apex, the calyx of an oblong cylindrical type, scarcely inflated, 10 ribbed. The habitat is moist mountain woods, often among bushes, along streambanks, in mountain meadows and other moist-wet sites; more rarely in drier situations and usually in the ponderosa pine and spruce belts. The forage value is variable, depending on abundance, associates, time of year, size of leaves, etc.

Oregon silene (***Silene oregana* S. Wats.**), originally known from the Blue Mountains of northeast Oregon, occurs in the mountains from Washington and Oregon (east of the Cascades) to northeastern California (questionable in northern Nevada), western Colorado, Wyoming, Montana, and Idaho. It is a more or less sticky-hairy, rather disagreeable-smelling plant 10 to 24 inches high, perennial from a usually perpendicular root. The leaves are few and narrow; the inflorescence is a narrow panicle, the calyx cylindrical or oblong club shaped and narrowed at base, usually 10 nerved; the 5 white petals are about ⅝ to ⅞ inch long, the base of the blades, or "claws," furnished with narrow appendages *(auricles)* and scales. Mostly in well-drained open sites, sandy or gravelly, occasionally loamy soils, from medium to subalpine elevations. It seems to be distasteful to grazing animals and is seldom nibbled.

Scouler silene (***Silene scouleri* Hook.**), dedicated to its discoverer, Dr. John Scouler (1804–71) who accompanied David Douglas on the latter's first western trip, occurs in dry grassy plains and in meadows, and open woods up to the ponderosa pine and aspen types, from Vancouver Island and British Columbia to Oregon and east to Utah, Colorado, and Montana. The plant is perennial from the woody branching crown of a taproot, the stems erect, 8 to 28 inches high; it is minutely hairy below and glandular and sticky above. The basal leaves are oblanceolate and up to 4 inches long and nearly ½ inch wide. The inflorescence is narrow and spikelike; the petal blades, or "claws," are deeply cut at the tip, ⅝ inch or more long and white or purplish. Ordinarily it is only limitedly cropped by sheep; on certain ranges of the Beaverhead National Forest (Montana), however, the palatability was considered poor for cattle and horses and fair for sheep.

Starwort *(Stellaria,* syn. *Alsine)*

Starworts, sometimes given the name of one member, the common **chickweed** ***(Stellaria media)***, compose a genus of annual or perennial herbs with opposite, linear to ovate leaves, often weak and spreading stems, and white clustered *(cymose)* flowers. There are about 25 western range species, of which at least 4 are widespread and common. The flowers in this genus consist of a calyx of usually 5 (sometimes 4) separate sepals; usually 5, sometimes 4 notched petals (lacking in some species); usually 10 (can be as

few as 2 in some species) stamens, and a pistil with mostly 3 (rarely 4 or 5) styles, usually opposite the sepals, and the fruiting capsules open nearly to the base by as many valves as there are styles, but the valves (being 2 cleft) appear to be twice as many. The stamens and petals are inserted around the margin of a disk under the stalkless *(sessile)* ovary.

Starworts are found on a wide variety of sites; however, the majority of the species occur in moist or wet places, and for the most part are small, sparse in stand, and relatively unimportant as range plants. In palatability they are generally considered fair cattle forage and fairly good sheep forage.

Under the old American Rules, *Alsine* L. (1753) had "page priority" (p. 272) over *Stellaria* L. (p. 421) but, under the now universal International Code, *Stellaria,* the name predominantly in favor, is acceptable and preferred. The artificial system of Linnaeus, based largely on numbers of stamens and pistils, necessitated putting these closely related species into separate genera, chickweed and some close relatives having fewer stamens than most starworts. The name *Stellaria* (from Latin *stella,* star) alludes to the resemblance of the flowers to conventionalized "stars."

Tuber starwort [*Stellaria jamesiana* Torr.,[23] syn. *Alsine jamesiana* (Torr.) Heller] (fig. 31), known also as James starweed and mountain chickweed, ranges, chiefly in moist sites, from the woodland and ponderosa pine to the aspen and spruce belts, from Wyoming and Idaho to Washington, California, and western Texas. In the Rocky Mountains and Intermountain Region it occurs from about 4,500 to 10,000 feet above sea level, but in the Northwest it may be found as low as 1,500 feet. Although occurring in a great variety of soils, it is more likely to grow on sandy or gravelly loams than in clayey soils. It is often common along streams, among shrubs, and especially in the aspen type.

The plant is a perennial herb, from tuberous rootstocks (which enable the species to propagate vegetatively, as well as from seed); there is a sticky glandular pubescence at least in the inflorescence; the stems are 4 angled, 4 to 24 inches tall. The stemless opposite linear to narrowly lance-shaped leaves are broadest at the base and up to 4 inches long; the white flowers have notched or 2-lobed petals about twice as long as the sepals.

Tuber starwort rates mention because of its wide distribution, frequent commonness and conspicuousness when in flower. The flowers are cropped by grazing animals, and the palatability of the herbage is fair or sometimes fairly good for sheep, and poor to fair for cattle. This variation depends chiefly on freshness of foliage and presence in quantity of more palatable associates. Occasionally tuber starwort is rather heavily grazed by both sheep and cattle; such extreme use, however, is associated with overgrazing and other undesirable conditions. The amount of forage

[23]The scientific name commemorates Dr. Edwin James (1797–1861), surgeon-naturalist of the Long Expedition (1819–20) to the Rocky Mountains. He discovered and named limber pine (*Pinus flexilis*).

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FIGURE 31.—Tuber starwort (*Stellaria jamesiana* Torr.).

produced per plant is small although this is one of the largest plants in the genus. The starchy tuberous rootstocks are edible and, when fresh and fleshy, are quite palatable with a pleasant, somewhat sweetpotatolike taste; they were an important source of food among the Indians.

Two species perennial from rootstocks and sufficiently widespread and common to deserve brief mention are described here:

1. **Longstalk starwort** [***Stellaria longipes* Goldie,** syn. *Alsine longipes* (Goldie) Colville] occurs on the banks of running streams, in wet meadows, around springs and other moist sites, also in spruce burns and rocky beaches of the arctic, from Greenland and Newfoundland to Alaska and south to California, Arizona, Colorado, South Dakota, Minnesota, northern Indiana, New York, New Brunswick, and Quebec. It has branched, 4-angled, smooth stems 4 to 12 inches high; linear-lance-shaped, ascending leaves up to about 1 inch long, and solitary or few long-stalked flowers on erect pedicels. It is occasionally grazed to a small extent but does not produce much herbage and usually grows where better forage plants occur.

About equally common and as widely distributed as ***Stellaria longipes*** is its **var. *laeta* (Richards.) S. Wats.** [syns. *Stellaria laeta* Richards., *Alsine laeta* (Richards.) Rydb.], which is smaller, with narrower, lance-shaped, sharp-pointed sepals, and reduced flowers in the leaf axils; this diminutive variety, hardly worth separation from the species, is too small to have forage significance. It occurs in Colorado up to at least 11,500 feet.

2. **Siberian starwort** (***Stellaria umbellata* Turcz.,** syn. *Alsine baicalensis* Coville), originally known from Siberia, occurs in the Blue Mountains of northeastern Oregon, the Sierra Nevada Mountains of California and east to the Rocky Mountains from Montana to New Mexico. It is a weak, decumbent or ascending plant, 1 to 12 inches high, with lance-shaped or narrowly oblong leaves up to ¾ of an inch long. The flowers are in umbels, often petalless or with the petals very small. The usual site is wet to moist meadows or in loamy soils, but it has been found growing in rock crevices on San Francisco Peaks, northern Arizona, at 12,000 feet. Ordinarily it is negligible as forage but, in some places, is fair sheep feed.

Chickweed [***Stellaria media* (L.) Cirillo,**[24] syn. *Alsine media* L.] is a native of Europe and Asia and perhaps also in parts of northern North America; now "almost universally distributed as a weed." It occurs in a naturalized condition in almost all parts of North America; its range in the United States is probably still spreading; it appears to be commoner in the East and on the Pacific coast than in the interior and is much more common around ranches and about towns and settlements than on the mountain ranges.

Chickweed is a weak, somewhat succulent, tufted and diffusely branched annual, the smooth stems prostrate, decumbent or ascending, rooting at the lower joints, and 4 to 16 inches long. The leaves, of an oval or oblong type, are up to 1½ inches long, the

[24]The surname of the 18th century Italian botanist Domenico Cirillo is often given as "Cyrill." in the manuals.

lower pairs very short stalked. The 5 white petals appear to be 10, each being deeply divided and surpassed in length by the 5 glandular-pubescent sepals. Frequent as a weed in gardens, lawns, fields, waste places, along irrigation ditches, etc. In the mountains generally in moist and cool sites, often on shady north slopes, up to about 9,000 feet in Colorado and about 3,000 feet in northern Idaho and Montana, often appearing in spring and autumn.

Mostly of minor importance or negligible as a range forage plant but reported to be relished by elk in winter on the Olympic National Forest (Washington). Chickens are especially fond of the plant, whence the common name, as are also many songbirds. Carruthers *(35, p. 308)* states that "this is not a poisonous plant" but adds that more information is needed on reports of its "causing disorder to the digestive system when eaten in great quantity by young lambs.

BUTTERCUP FAMILY (RANUNCULACEAE)

This large, chiefly Northern Hemisphere family is represented in the western range country by about 19 genera and 226 species. It is noteworthy for its acrid juices, its large number of ornamental plants often with flowers of unusual shapes, and its importance from a range stock-poisoning standpoint. In addition to medicinal plants mentioned under their respective generic headings, an eastern plant, **goldenseal** ***(Hydrastis canadensis* L.)** has rootstocks which have been in so much demand medicinally that the plant is almost extinct in a natural condition.

Anemone Tribe (Anemoneae)

Adonis *(Adonis)*

Adonis, sometimes called "pheasant-eye," is an Old World group of annual or perennial herbs with alternate dissected leaves and showy, solitary, terminal yellow, orange or red flowers composed of 5 to 8 sepals and 5 to 16 petals (the latter without nectar pits), and numerous stamens and pistils; the fruit is an elongated or rounded head of achenes. Probably all the species are in ornamental cultivation and, from this fact, at least three species have limitedly escaped and become locally naturalized in range areas of the West. The genus perhaps should be dismissed from consideration from the range standpoint except for its apparently active chemical properties. **Spring adonis** ***(Adonis vernalis* L.)** is an official drug plant, its dried herbage being used as a heart stimulant, the drug often adulterated with other species of the genus which appear to have the same properties but to a lesser degree.

Anemone *(Anemone)*

Perennial herbs, with compound or dissected leaves both basal and, opposite or whorled, forming a sort of stem involucre to the long-stalked flowers. There are no true petals, the sepals several or numerous and petallike, the stamens and pistils numerous. The

fruit is a rounded, oblong, egg-shaped or elongated and dense head of numerous flattened and pointed often cottony achenes. *Anemone* is the Greek name for these plants, presumably derived from *anemos*, wind; they are frequently called "windflower." Anemones are represented in the West by about 18 species, where they occur on moist and well-drained soils from near timberline on the mountains to the lower elevations in the foothills and valleys, in both open and shaded situations.

The flowers of some species are produced very early, with the first advent of spring, adding their bright colors to the rather drab landscape of the season. Various species are cultivated because of their beautiful, showy flowers and, in several cases, for their striking foliage as well. Some species constitute fair forage for sheep, deer, and elk, but, in the main, anemones are practically worthless for cattle and only poor for sheep. Ordinarily, they are insignificant for forage purposes largely because the more succulent species appear early and quickly desiccate.

It is possible that all anemones contain "anemone-camphor," or "oil of anemone," from which are derived anemonic acid and anemonin, the latter a bitter ring ketone and poisonous narcotic. Fresh anemone plants are more or less acrid and the fresh juice of some species may be irritating to the skin and eyes of some people *(123, 151, 211)*. It has been reported *(211)* that **European wood anemone** ***(Anemone nemorosa* L.)** has caused illness of cattle in Europe, but there appears to be no record of anemone poisoning livestock in this country. Some species of anemone were used by the ancient Romans as a treatment for malarial fever, and Gilmore *(80)* reports that American Indians used anemone roots in the treatment of wounds and attributed to them mystical healing powers.

The four common species of anemone briefly annotated below are reasonably representative of the western range:

1. **Candle anemone** ***(Anemone cylindrica* A. Gray)** occurs in woods and along streams from New Brunswick and Maine to New Jersey, Ohio, Missouri, Arizona, Utah, and eastern Idaho. The books include British Columbia in its range but that seems open to question. It is a silky-hairy plant about 1 to 2 feet high, the leaf blades 3 cleft, those involucred on the stem 3 or more and long stalked. The flowers, mostly 1 to 3, are whitish, yellowish, pinkish, or purplish. The fruiting heads are elongated cylindrical, whence the common name "thimbleweed," the small fruits *(achenes)* long and cottony. While occasionally observed to be grazed the plant's palatability is normally low or worthless.

2. **Threeleaf anemone** ***(Anemone deltoidea* Hook.)** occurs chiefly near the coast, from British Columbia south to Del Norte, Siskiyou, Humboldt, and Trinity Counties, northern California, mainly in fertile loamy soils, often in or on the edge of timber and frequently along streams, between about 100 and 5,000 feet elevation; often common and abundant, flowering from late May through August. It is a smooth (or nearly so) plant with slender rootstocks, stems 4 to 14 inches high, 3-leafletted basal leaves, the leaf-

lets ovate and toothed, and 3 stalkless (or nearly so) simple stem leaves that are saw toothed or sometimes 3 lobed. The white flowers are solitary, the achenes not woolly, in a rounded or egg-shaped head. Ordinarily negligible as forage.

3. **Globe anemone** [***Anemone globosa* Nutt.**, syn. *A. multifida* var. *globosa* (Nutt.) Torr. & Gray] (fig. 32), also known as mountain anemone and Pacific anemone, ranges from Alaska to New Brunswick and the New England States and, southward, to South Dakota, Colorado, the San Francisco Peaks of northern Arizona, and northern California. Its botanical nomenclature is in dispute. Some authorities consider it a variety or synonym of the subarctic northeastern North America ***A. hudsoniana* (DC.) Richards.** (syn. *A. multifida* var. *hudsoniana* DC.) and others, a variety or synonym of the South American ***A. multifida* Poir.** There is no doubt that *A. globosa* is closely related to the two (typically) smaller flowered species mentioned. Globe anemone is a hairy plant with a stout rootstock, stems 4 to 20 inches high, the leaves compoundly divided in 3's *(2- to 4-ternate)*, their ultimate segments rather narrow, the flowers greenish yellow, pinkish, or bluish purple with stout and short styles.

The species is probably the most abundant anemone in the West and occurs in meadows, valleys, and foothills from about 4,000 feet up to timberline (12,000 feet). It occupies a variety of soils on either dry or moist sites, prefers sunny situations, but occasionally appears in open timber stands. As forage, globe anemone is unimportant, ordinarily being practically worthless for all classes of livestock. On some national-forest areas in Montana, Colorado, and Utah it has been rated poor to fair for sheep, and it is probably eaten to some extent by deer and elk.

4. **American wood anemone** ***(Anemone quinquefolia* L.**, incl. *A. piperi* Britton, a western form of the species which intergrades completely) ranges from New Brunswick and Nova Scotia south to Tennessee and Georgia, west to western Ontario and Minnesota, entering the western range country in northern and western Idaho, Oregon, Washington, and British Columbia. It is a rather low (4 to 9 inches high) delicate spring herb, perennial from slender, whitish or brown horizontal rootstocks. The stem bears an "involucre" of 3 distinctly stalked *quinquefoliolate* ("5 leaved") or *trifoliolate* ("3 leaved") leaves, and solitary white or whitish flowers usually with 5 or 6 sepals. The spherical fruiting head is somewhat bent inwards, the individual seedlike fruits *(achenes)* noncottony but fine-hairy.

This species is often abundant in rich more or less shaded sites, as in conifer stands in the mountains between about 2,500 and 5,000 feet. It seems to be unimportant as forage but has been rated as fair spring deer feed on the Allegheny National Forest (Pennsylvania). On western range it generally disappears by the time livestock enter in the spring.

Anemone quinquefolia has been confused with the cultivated **European wood anemone** ***(A. nemorosa* L.)**, which has become limitedly naturalized in this country; that species, however, has

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FIGURE 32.—Globe anemone (*Anemone globosa* Nutt.): *A*, Fruiting heads; *B*, individual fruit (*achene*).

a somewhat coarser habit, paler hue, less lobed leaf divisions, and a conspicuously stouter and blackish rootstock. *A. nemorosa* is reported occasionally to sicken domestic animals in Europe and both it and our American plant cause an inflammation of the skin to certain sensitive persons.

Lyall anemone [***Anemone quinquefolia* var. *lyallii* (Britton) Robins.**, syn. *A. lyallii* Britton], named for its discoverer, Dr. David Lyall, surgeon-botanist of the middle 19th Century International Boundary Survey between the United States and Canada, and **Oregon anemone** [***A. quinquefolia* var. *oregana* (A. Gray) Robins.**, syn. *A. oregana* A. Gray], are sometimes recognized as western variations of American wood anemone.

Closely related to the anemones and united with them, as a subgenus, by many botanists are the **pasqueflowers** ***(Pulsatilla spp.)***.[25] *Pulsatilla* is distinguished from typical *Anemone* by its elongated, clematislike, densely feathery styles, very conspicious in fruit; its noticeably larger flowers (the sepals sometimes 1½ to 2 inches long), and the presence among the stamens of glandlike *staminodia*, or abortive nonfunctional stamens.

Hardly any two American manuals agree as to the scientific name of our **American pasqueflower** [***Pulsatilla ludoviciana* (Nutt.) Heller**, syns. *P. hirsutissima* Britton, *P. occidentalis* (S. Wats.) Freyn., *Anemone ludoviciana* Nutt., *A. occidentalis* S. Wats.]. This confusion is due to disagreement as to whether or not (1) our species is confluent with the Old World **spreading pasqueflower** [***Anemone patens* L. = *Pulsatilla patens* (L.) Britton & Brown**], (2) *Pulsatilla* is a valid genus distinct from *Anemone*, (3) the more western form should be separated as a distinct species, *P. occidentalis*, and (4) our species should be segregated into varieties, such as *nuttalliana* and *wolfgangiana*.

Regarding American pasqueflower as one and endemic to North America, its range is from Wisconsin and northern Illinois and west to South Dakota, Montana, Saskatchewan, Alberta, British Columbia, and Alaska, south to California (apparently absent from Arizona), New Mexico, and western Texas. It is the State Flower of South Dakota *(87)*. Other common names for this plant include April-fools, Easter-flower, hartshorn, headache-plant, mayflower, rocklily, wild-crocus, and windflower.

The Dakota Indians dub the pasqueflower hakshi-chekpa-walicka, meaning twin flower, because usually each plant bears just two flowering stalks *(80)*. This may be misleading, as although it is possible that two stems are produced more often than any other number, plants with only one stem or with several stems are not uncommon. In Great Britain pasqueflowers are often called "Danesblood," due to an early tradition that these plants first appeared on battlefields stained with the blood of invading Danish warriors.

American pasqueflower is a low, densely silky-hairy perennial,

[25] *Pulsatilla* is an Italian name Latinized by medieval botanists; its significance is uncertain, although it may refer to the throbbing caused by the irritation of poultices made from these plants.

with mainly 3 parted, dissected leaves, and large and showy purplish-blue to whitish flowers. The plant occurs mostly in rather dry, sandy, or rocky sites and has a wide altitudinal range (about 4,000 to 10,000 feet). At the higher elevations, it appears on exposed, sunny slopes, but at lower altitudes, it occurs both in the open and in the shade of trees and shrubs, being especially characteristic of open stands of ponderosa pine. It blooms in the early spring before the leaves appear and often at the edge of melting snow; "pasque" (signifying Easter or the Jewish Passover) refers to the early flowering.

This species contains a volatile oil *anemonol,* or "pulsatilla camphor," *anemonin,* etc. *(211, 216),* and is listed by Pammel *(151, 152)* as a poisonous range plant. However, there is no record, apparently, of any livestock losses from it. Its palatability is low, and it produces but a small amount of herbage, which matures and largely desiccates by midsummer and ordinarily is only slightly grazed, if at all.

The Indians use the crushed leaves of American pasqueflower in the treatment of rheumatism and similar diseases; the leaves are applied as a poultice, but if left in contact with the skin long enough will cause blistering *(80).* The dried herbage of this species is sometimes used as a source of the drug, pulsatilla; the official source of that compound is the dried herbage of Old World species, especially the **European pasqueflower** ***(Pulsatilla vulgaris*** **Mill.,** syn. *Anemone pulsatilla* L.). The plants are collected shortly after blooming and carefully dried. The material loses its medicinal value if preserved much longer than 1 year. The drug, used for disorders of menstruation, is a counterirritant; in overdoses it causes vomiting and purging with pain, tremors, and collapse.

Clematis *(Clematis)*

This large, familiar genus, many members of which are in ornamental cultivation, is chiefly woody plants climbing by means of twisting leafstalks. Frequent other common names for the group are virginsbower and travelers-joy. It is annotated in the Range Plant Handbook *(204)* and Important Western Browse Plants *(54).* The genus is remarkable in this family because of its opposite leaves. The variability of the genus is reflected in its sections:

Flammula (perhaps the most familiar form of clematis in this country), with sexes distinct, climbing over bushes and with massed clusters *(cymose-paniculate)* of small, white, fragrant flowers with four spreading sepals.

Atragene, with 3-leafletted leaves, and large solitary (or in 3's) nodding flowers with thin, separate, divergent sepals, the filaments of the outer stamens broadened and more or less petaloid.

Viorna, or **leatherflower,** with simple or compound leaves, and solitary, upright or nodding, long-stalked, more or less leathery textured and urn-shaped, often purplish or brownish flowers.

Viticella, an Old World showy group, shrubby climbers with

leaves of various types, and large starlike flowers of various colors, solitary or in threes.

The common herbaceous western range species is **Douglas clematis,** also known as Douglas leatherflower, hairy clematis, and sugarbowls [***Clematis hirsutissima* Pursh,** syns. *C. douglasii* Hook., *Viorna bakeri* (Greene) Rydb., *V. douglasii* (Hook.) Cockerell, *V. eriophora* Rydb., *V. hirsutissima* (Pursh) Heller], which ranges on the east side of the Cascades from British Columbia to Grant County, Oregon, east to Utah, Arizona north of the Grand Canyon, northern New Mexico, Colorado, Wyoming, and Idaho.

It is an erect perennial, 8 to 28 inches high, of varying hairiness (responsible in part for the segregated species proposed), perennial from a woody base. The lowest leaves are small, undivided and bractlike, the others twice or thrice pinnate with the ultimate divisions linear or lance shaped. The brownish-purple flowers are solitary and nodding on a naked stalk, the 4 leathery sepals erect but with recurved tips, up to 2 inches long. The small fruiting achenes are silky-hairy, their persistent styles in fruit up to 2½ inches long. The plant usually flowers in May and June and disseminates from the middle of July on. It usually occurs scatteringly in well-drained soils in the open or at least under moderately lighted situations.

The palatability of Douglas clematis to domestic livestock varies from zero or low to fair and is more palatable to sheep than to cattle and horses. Such value as it possesses is in the forepart of the season, because it soon becomes dry and uninviting. Like all clematises it is more or less acrid and the herbage has a bitter taste. Charles Andreas Geyer (1809–53), early plant explorer of the West, reported *(78)* that "the Saptona Indians use the root of this plant as a stimulant, when horses fall down during their excessive races. They hold a scraped end of the root into the nostrils of the fallen horse. The effect of this is instantaneous, it produces trembling; the animal springs up, and is led to the water * * * The scraped root leaves a burning sensation for half a day, if touched with the tongue." Some clematises were formerly used medicinally as counterirritants and as blistering agents *(125)*.

Mousetail *(Myosurus)*

This is a widely distributed genus of diminutive stemless (except for the flower and fruit stalks), almost grasslike annuals with fibrous roots. The threadlike, linear or narrowly spatula-shaped leaves are in a basal tuft. The flowers are small; greenish-yellow petals are frequently present; there are usually 5 sepals conspicuously spurred at the base; stamens about 5 to 25. The numerous pistils are borne on a cylindrical terminal axis that elongates and becomes spikelike in fruit—giving rise to both the common and scientific names [the latter from Greek *muos* (mouse's) + *oura* (tail)].

There are about nine western range species of this genus. They are often common in moist meadows and woodlands or weed-grass types, frequently in sandy or gravelly clay loams up to elevations

of 9,000 feet or so. Some species occur in bogs and others in alkaline seeps. Apparently there is no record of their being grazed by domestic livestock and, even if grazed, they are too small and short lived to have any importance.

Meadowrue *(Thalictrum)*

Meadowrues are erect, mostly leafy-stemmed herbs, perennial from rootstocks, with alternate, ternately compounded, columbine-like leaves. The leaflets are usually three lobed and often more or less toothed. The flowers of meadowrues lack petals and, although individually small, are often showy collectively in terminal clusters (panicles or occasionally racemes); the early-falling, petallike floral bracts *(sepals)* are greenish, whitish, or purplish. The flowers of a few species are perfect, containing both male, or pollen-producing organs *(stamens)* and female, or seed-producing organs *(pistils);* in most species the pistils and stamens are borne in separate flowers on separate plants *(dioecious)* or occasionally perfect flowers are intermixed with male and female flowers *(polygamous)*. The male flowers are often attractive with their numerous, delicate, colored stamens.

Meadowrues are much alike in general appearance; but besides differing in characters such as racemose vs. paniculate flowers, threadlike vs. club-shaped filaments, 1- or 2-sexed plants, fruit ribbing and shape, they are chiefly dissimilar in size, leafiness of stems, shape, size, and texture of leaflets, and color of roots. Field determination of species is not always feasible; fortunately it is seldom, if ever, required for range management purposes. Meadowrues are abundant locally, and in general their palatability is practically worthless to poor for cattle and poor to fair for sheep. However, in some instances they may be utilized rather closely, especially on ranges that are heavily grazed early in the season. Excessive use of meadowrues generally indicates overstocking. Deer crop these species slightly; possibly they are also utilized by elk. The herbage has a somewhat tanninlike, acrid taste.

Approximately 14 species of meadowrue grow in the Western States, the majority inhabiting the Rocky Mountains. They prefer rich, moist soils and some shade and appear in greatest abundance in aspen and among shrubs. However, they are often found in full sunlight in meadows and parks.

Meadowrues derive their name from the meadow habitat of the typical Old World species—a habitat which is rather characteristic of the genus as a whole—and from a fancied resemblance of the foliage to that of **common rue *(Ruta graveolens* L.)**. However, the bitterness of the leaves in meadowrue lacks the peculiarly acrid character of rue. Certain species of meadowrue are sometimes known as "poor-man's rhubarb," because their herbage was formerly used as a substitute for rhubarb. *Thalictrum* is Latinized from *thalictron,* a name used by the Greek medical writer, Dioscorides first century, B.C.), for a plant thought to be the Old World **low meadowrue *(T. minus* L.)**.

Because of their feathery masses of male flowers, their graceful

foliage, often in pleasing contrast to purplish stems, and their hardiness, many of the meadowrues are grown as ornamentals. Some species are suitable for mixed borders and rock gardens; the robust forms are valuable in wild gardens. Some native range species, **alpine meadowrue (*Thalictrum alpinum* L.)**, **early meadowrue (*T. dioicum* L.)**, and **veiny meadowwrue (*T. venulosum* Trelease)** have been used commercially for some time.

There is evidence that some species of meadowrue have active chemical properties; hence a thorough study of the genus from this standpoint would be of interest and value. The roots of **bigfruit meadowrue (*Thalictrum macrocarpum* Gren.)** of southern Europe are the source of a crystalline yellow, extremely toxic substance like curare, which is used by South American Indians for poisoning arrows and darts. This substance consists of *thalictrine,* an alkaloid insoluble in water, and *macrocarpin,* a yellow crystalline body soluble in water, representing the coloring principle of *Thalictrum.* The roots of some species yield a yellow dye suitable for woolens. The same elements occur in the roots of **yellow meadowrue (*T. flavum* L.)**, known also as "fenrue" and "monk's rhubarb," and in **dusty meadowrue (*T. rugosum* Aiton,** syn. *T. glaucum* Desf.) of Europe, as well as in **snoutseed meadowrue (*T. rhynchocarpum* Dillon & A. Rich.)** of north Africa.

Thalictrine is a very active cardiac poison, which causes loss of power, convulsive movements, irregularity and depression of the heart beat, and finally death *(147).* Although possibly the American species contain the same toxins as the foreign species, no livestock losses attributable to these plants have been recorded. Domestic animals, to be sure, would hardly be tempted to eat the bitter roots even if accessible. Chesnut *(38)* writes that an Indian once reported a white child as being poisoned by eating the stems of **Sierra meadowrue [*Thalictrum polycarpum* (Torr.) S. Wats.]**, a Pacific species, ranging from Oregon to Lower California. He further reports that, among some California Indian tribes, that plant is known as "coyote angelica," angelica being a universal charm and panacea of Indians and the coyote symbolizing their idea of cunning. These Indians believe that coyotes eat this meadowrue without ill effects.

Two of the most common and characteristic western meadowrues are briefly annotated here:

1. **Fendler meadowrue (*Thalictrum fendleri* Engelm.)**[26] (fig. 33), ranges from (southeastern Oregon?) to Idaho and western Montana and south to (the mountains of) western Texas, northern Mexico, Arizona, and eastern California. It is often abundant locally, and occurs chiefly in moist, loam soils in aspen or among shrubs, although also found in open exposures and, to some extent, in ponderosa pine, Engelmann spruce, and other coniferous timber, up to elevations of about 10,000 feet. It is about 1 to 3 feet tall, the

[26]The species commemorates August Fendler of St. Louis, Mo., who first collected it in the mountains near Santa Fe, N. Mex. Fendler's collections in New Mexico, 1846–47, formed the basis for Dr. Gray's well-known book Plantae Fendlerianae.

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FIGURE 33.—Fendler meadowrue (*Thalictrum fendleri* Engelm.). Male flowers above at right; female flowers below at right; single achene, or fruit, lower right.

sexes distinct, with rather small leaflets (under 3/5 of an inch long), threadlike anther stalks *(filaments)*, and 3-ribbed, oblique, reverse egg-shaped *(obovoid)* fruits *(achenes)*.

On properly grazed ranges Fendler meadowrue is practically

worthless to poor in palatability for cattle and poor to fair for sheep. On very heavily grazed ranges it is sometimes almost completely utilized, but ordinarily the close cropping of this species indicates overstocking. Kennedy *(112)* reported that sheep on western Nevada ranges were very fond of this plant.

2. **Western meadowrue** ***(Thalictrum occidentale*** **A. Gray)** favors rich, damp loam and on such soils may be the predominant plant. It occurs in shaded habitats of partly open aspen and conifer timber, from British Columbia and Vancouver Island to northern California, Utah, Montana, and Alberta. It is a medium-sized, much branched plant about 2 to 3 feet tall; the leaflets are thin and inconspicuously veined; the plant has separate sexes *(dioecious),* the stamen stalks *(filaments)* of the male plant are threadlike; the narrowly spindle-shaped fruits are tapered at both ends, 6- to 8-ribbed, and ¼ inch or more (6 to 8 mm.) long.

This species is usually of little or no value as forage but may be lightly grazed by sheep in certain sections. Darlington *(49)* states that on national-forest ranges in Washington and Oregon it is regarded as unpalatable and worthless. However, on Idaho national forests, it is generally rated as fair to good sheep feed.

False-bugbane [*Trautvetteria carolinienis* (Walt.) Vail., syns. *T. grandis* Nutt., *T. media* Greene, *T. palmata* (Michx.) Fisch. & Mey.] is an erect herb, perennial from a mass of fibrous roots, up to 40 inches high. It has alternate leaves sometimes as much as 8 to 12 inches wide, of a broadly kidney-shaped *(reniform)* outline and deeply and digitately 5- to 11-lobed, the lobes in turn lobed, cut or toothed and separated by rounded sinuses; the root leaves are long stalked, the stem leaves short stalked or stalkless and reduced in size. The inflorescence is long stalked with numerous flowers in a *(corymbiform)* flattened or convex cluster; the flowers are petalless, with 3 to 5 soon-falling greenish white sepals, and numerous white and rather showy stamens. The fruit is a podlike *follicle* (somewhat similar to that of a larkspur or columbine), tipped with the bristlelike persistent recurved style.

Trautvetteria is a small or perhaps monotypic genus of North America and Asia and much in need of further study. Most western manuals call our western plant *T. grandis.* As compared with (typically eastern) *T. caroliniensis, T. grandis* typically has thinner and less conspicuously net-veined leaves; its stem leaves are usually short stalked rather than stalkless, and it has smaller, broader fruits more rounded at base and tipped with a longer style. The segregate known as *T. media* Greene, of New Mexico and southern Utah, has slimmer, less club-shaped stamen stalks *(filaments)* which are not broader than the anthers, shorter styles, and the fruits are hardly rounded at the base. It appears to merge hopelessly into the typical form.

It seems better, as some botanists are now doing, to merge *Trautvetteria grandis* with the eastern *T. caroliniensis* (an older name) and consider our plant as growing across the continent, from Pennsylvania to Florida, and west to central California, and British Columbia. The species grows in moist mountain woods, often near

or along streams, up to subalpine elevations. It flowers from June to August. Opinions as to its palatability and value vary greatly and more study of this matter is needed. The genus derives its scientific name from Ernst Rudolph von Trautvetter (1809–89), distinguished Russian botanist.

Hellebore Tribe (Helleboreae)

This tribe is typified by the true **hellebores** ***(Helleborus* spp.)** of the Old World, at least two members of which, **Christmas-rose,** or **black hellebore** ***(H. niger* L.)** and **Lenten rose,** or **Oriental hellebore** ***(H. orientalis* Lam.)** are in popular cultivation in this country as ornamentals. The plants of this genus are poisonous, having strong cathartic, diuretic, and cardiac influences. Hippocrates (b. 460 B.C.), "the father of medicine," wrote of black hellebore (*H. niger* L.) ; the plant was deemed by the ancients to be useful in the treatment of madness, the Greeks having a verb *helleboriao* meaning "to need hellebore."

Monkshood *(Aconitum)*

Monkshoods compose a fairly large chiefly Asiatic genus of perennial herbs, represented in the Far West by about nine species, although a number of segregates have been proposed. Washington, Idaho, and Montana have one species apiece; the Intermountain Region, with six species, appears to be the center of distribution for the genus in this country. Other common names used for the genus are aconite and wolfbane; the latter name, however, is perhaps best restricted to the Old World *Aconitum lycoctonum* L., and aconite to the cultivated drug plant, *A. napellus* L. *Aconitum* is the classical name for these plants.

The roots of all western monkshoods are perennial, many are clustered, and most of them tuberous; these parts should always be represented when plants are collected, because they vary considerably in different species *(165, 166)*. The pithy or solid, often slender stems are frequently solitary, 1 to 6 feet tall, and vary greatly in leafiness and hairiness. The alternate leaves are palmately lobed or divided, the lower ones long stalked, and the upper ones somewhat reduced in size and short stalked. The showy and ornamental, irregular flowers appear from mid- to late summer and are wholly unlike those of any other plant in our flora, being readily identifiable by the peculiar helmet-shaped hood formed by the large upper sepal.

The fancied resemblance of the flower to the hood that a monk commonly wears is the origin of the English name, monkshood. The flowers occur in short, few-flowered or long and many-flowered, branched clusters, and are characteristically deep blue, although they may vary from violet to white or yellowish. Frequently, the fruits *(follicles)* in the lower part of the cluster have matured their seed while the upper flowers are still in blossom.

The western species of monkshood, when not in bloom, may be confused with tall species of larkspurs *(Delphinium* spp.), with

which they are frequently associated, because of the similarity of the leaves and the somewhat analogous growth habits. Differentiation between the destructive, poisonous larkspurs and the ordinarily harmless monkshoods is not especially difficult, as the latter have solid or pithy stems in consrast to the hollow stems of the larkspurs. Furthermore, the roots of western monkshoods are short, clustered, somewhat fleshy, and tuberlike with short, yellowish rootlets, whereas the tall larkspurs have long, dark-colored, fibrous roots from well-developed, tough, somewhat woody root crowns.

When the plants are in bloom, the irregular flowers of monkshood with the hoodlike upper sepal are so distinctive as to be readily recognizable; the spurred flowers of the larkspurs are also unmistakable. Early in the season, before the stems develop, the western monkshoods may be confused with the species of wild geranium, or cranesbill *(Geranium* spp.) because the leaves are very similar, but ordinarily the crushed foliage of the latter has the characteristic geranium odor.

In the West, monkshoods grow chiefly in the mountains, usually singly or in small patches, and seldom occur in great abundance over large areas. They appear commonly in moist open woods, along creeks, in meadows and grasslands, often extending into the higher mountains where the growing season is short. Their habitat is similar to that of the closely related larkspurs. Although widely distributed, monkshoods are seldom, if ever, sufficiently abundant to attain major importance on the range. They often constitute fair feed for sheep, poor or worthless for cattle, and are but rarely grazed by horses.

Although technically poisonous, monkshoods probably seldom, if ever, cause fatalities or even sickness under range conditions. The most poisonous part of monkshoods is the root, usually inaccessible and unattractive to livestock. The seeds are also poisonous. This matter is discussed in greater detail under *Aconitum columbianum,* the most important western species of the genus.

The important drug aconite, an arterial and nervous sedative used to alleviate pain in such disorders as facial neuralgia, toothache, and sciatica, is commercially obtained from the roots of the Old World plant *Aconitum napellus* L. *(147)*—the species of *Aconitum* most commonly cultivated in the United States as an ornamental. The chief active principle of aconite is the group of closely related alkaloids called *"aconitine"* ($C_{33}H_{43}NO_{12}C_{34}H_{47}NO_{11}$ * * *), powerful poisons. Apparently exact chemical structure of these alkaloids varies in the different species. McNair *(127)* reports that the various aconitines have been found only in this genus, which is noteworthy in giving a new chemical species of *"aconitine"* for each apparently closely related species. The American Pharmaceutical Association in 1938 concluded that tincture of aconite, as then prepared under the U.S. formula, was "of no significant clinical value" and that the preparation and standardization of the drug appeared to need further study *(195).*

Monkshoods are attractive hardy perennials much used for bord-

ers and mass formations in horticultural plantings because of their showy flowers and attractive foliage. They are reproduced by root division as well as from seed. However, these plants should not be planted in or near kitchen gardens or in children's gardens as their roots, leaves, and sometimes the flowers may cause poisoning *(8)*.

Columbia monkshood ***(Aconitum columbianum*** **Nutt.,** syns. *A. arizonicum* Greene, *A. patens* Rydb.) (fig. 34) is representative of the western species of *Aconitum* both in appearance and palatability and is the most common and widely distributed species of this genus in the West. It is a tall, perennial herb inhabiting all of the 11 western range States and occurs from British Columbia to California, New Mexico, and Montana. The common and specific names refer to the Columbia River, the first botanical description of this species resulting from a plant collected on the Columbia River near Walla Walla, Wash., about 1834.

Columbia monkshood prefers moist, shady sites along streams and around springs in the foothills and mountains at elevations of from approximately 1,000 to 12,000 feet, but it is most frequent at the higher elevations. It grows in a great variety of weed, grass, and timber types, is common in aspen and among willows, and occurs frequently in moist mountain meadows. This plant is seldom, if ever, the dominant species in areas it inhabits, though it not infrequently grows in small, dense patches. It flourishes in deep, moist, sandy or clayey loams, especially if rich in humus.

Columbia monkshood is an erect, stout, single-stemmed plant, from 2 to occasionally 6 feet in height, the stem being solid or pithy within, more or less hairy or somewhat sticky above. The front line of the beaked flower "hood" is almost straight. This species has not as yet come into general use as an ornamental, although it is fully as handsome as a number of its sister species commonly grown for horticultural purposes.

Columbia monkshood, while recognized as potentially poisonous to cattle, is very rarely, if ever, consumed by such animals in sufficient quantities under range conditions to cause losses. The use of this species varies considerably in different parts of the West. In California, the Southwest, the Intermountain Region, and Idaho, cattle seldom touch it, and sheep usually either ignore it or merely pick off some of the leaves and tops. In the northern Rocky Mountains, from Montana to Colorado, its utilization seems to be greater, sometimes being considered of fair palatability for cattle and fairly good for sheep. The greatest range use of the species ordinarily occurs on summer ranges of the Northwest where sheep frequently utilize from 70 to 80 percent of the herbage, and cattle between about 30 and 60 percent.

Nearly all the Western United States literature on poisonous properties of monkshoods is concerned with Columbia monkshood. Marsh *(129)*, in writing of this species, says: "Monkshood, as is well known, is a poisonous plant, but somewhat extensive experimental work by the Department of Agriculture has demonstrated that it does not poison livestock on the range." However, in the

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FIGURE 34.—Columbia monkshood (*Aconitum columbianum* Nutt., syns. *A. arizonicum* Greene, *A. patens* Rydb.). Individual flower and cluster of fruiting follicles in lower right.

legend to his colored Plate 9 of this species, Marsh adds: "Although poisonous plants, monkshoods do not poison cattle," saying nothing about other kinds of livestock. Chesnut *(37)* states categorically that Columbia monkshood "sometimes poisons sheep" in the Northwestern States.

In Colorado, Glover and Robins *(82)* report that this species "is a very poisonous plant but because of its limited distribution, and its widely scattered habit of growth, it is not much eaten. Animals have been seen to reject the plant even after taking it in the mouth, because of its peculiar local effect." Gail *(77)* in Idaho, also writing of Columbia monkshood, said: "In the case of the horse the animal falls down and is unable to rise."

Beath and cooperators *(13, 15)*, in discussing Columbia monkshood, state: "The losses from aconite poisoning are camparatively small" and "It has been demonstrated that cattle are not susceptible. Sheep and horses may be fatally poisoned by aconite." It would appear from Beath's investigation that Columbia monkshood would not make a satisfactory substitute for the Old World *Aconitum napellus* as a source of the drug aconite *(14)*. He found *A. columbianum* less than 0.5 percent as active as *A. napellus*. Muenscher*(141)* reports that the toxicity of this plant varies with the climatic conditions of the habitat and that it "seems to be most poisonous just before flowering."

Columbia monkshood is frequently associated with tall larkspurs, which are responsible for heavy cattle losses in the West. In some localities, such as certain parts of Yellowstone Park, Columbia monkshood grows in great abundance whereas larkspurs are comparatively rare; in other places, such as the region between Yellowstone Lake and the Grand Canyon, the larkspurs are very abundant and Columbia monkshood is infrequent *(129)*. Inasmuch as the tall larkspurs are very poisonous, especially in the spring and fall, and Columbia monkshood, though possessing poisonous properties, seems to be negligible as a cause of range cattle losses, it is of great importance to learn to distinguish these plants in the field. (See pp. 154–155.)

Baker monkshood [*Aconitum bakeri* Greene, syns. *A. columbianum* var. *bakeri* (Greene) Harrington, *A. porrectum* Rydb., *A. robertianum* Greene] is, next to Columbia monkshood, probably the commonest of western monkshoods. It ranges in moist to wet open subalpine situations, chiefly in sandy loams, between 7,000 and 12,000 feet, from Wyoming and Colorado to Utah and New Mexico. It is distinguished from Columbia monkshood chiefly by its somewhat smaller size (16 to 28 inches high), compact almost spikelike inflorescence, and by the front line of the "hood" sepal being concave instead of nearly straight, with a nearly horizontal *(porrect)* beak; there are some minor but inconstant differences.

Although reported as "poisonous" by collectors on the Gunnison and San Isabel National Forests (Colorado), no losses have ever been attributed to this species so far as Forest Service records indicate. The herbage usually appears to be distasteful to cattle but it is taken sometimes by sheep and apparently with impunity.

Typically, the plant is more sticky (viscid or glutinous) at the top than Columbia monkshood and its palatability probably averages somewhat less than that of the latter species. The species commemorates Charles Fuller Baker (1872–1927), well-known western entomological and botanical collector, after whom Dr. E. L. Greene named his serial Plantae Bakerianae.

Baneberry *(Actaea)*

This is a small Northern Hemisphere genus of closely related, erect perennial herbs with ternately compound leaves, small flowers in dense terminal spikelike racemes, a solitary pistil, and the fruit a berry. The fruit of all species appears to be somewhat poisonous —whence the common name. The type of the genus, the Old World **black baneberry *(Actaea spicata* L.)**, of which older botanists considered our American species to be varieties, has the reputation of sometimes poisoning sheep. Baneberries are occasionally cultivated as ornamentals. The scientific name is derived from Greek ακτέα, which was the classical name of the **European elder (*Sambucus nigra* L.)**, the name having been deliberately transferred by Linnaeus to the baneberry genus. There are three or four western range species of the genus, of which western baneberry is the most common and important.

Western baneberry [*Actaea arguta* Nutt., syn. *A. spicata* var. *arguta* (Nutt.) Torr.] (fig. 35), also known as western red baneberry, is found from Alaska to central California, Arizona, Montana, Alberta, and South Dakota. It is sometimes confused with a typically eastern species, **red baneberry [*A. rubra* (Aiton) Willd.]**, which, however, gets into the northern Rocky Mountains area, and which has noticeably larger and elliptical fruit on much more slender (instead of thick and stiff) stalks (pedicels). Western baneberry has rather stout stems, 16 to 32 inches tall, branched above, slightly hairy, with brown sheaths at the base. The small white flowers have 3 to 5 petallike, soon-falling sepals and 4 to 10 small, clawed petals shorter than the numerous, slender-stalked stamens. The fruits are rounded and red.

The plant occurs chiefly in rich moist soils, either in the open or in shade, often in aspen or spruce types, along streams or around the roots of willows; in Montana and Idaho between elevations of about 3,500 to 7,500 feet, in Utah and Nevada mostly at 8,500 to 9,500 feet or more. Ordinarily the plant is regarded as unpalatable and worthless, but there appear to be occasional exceptions. It has been reported to be eaten by horses on the Flathead National Forest (Montana) range, and to be fair sheep feed on the Boise National Forest (Idaho).

Widely distributed in Canada and the United States, with about the same range as *Actaea arguta* plus *A. rubra*, is a form with ellipsoid *white* berries known in literature as "*A. alba* (L.) Mill." and *A. eburnea* Rydb. Probably the best disposition of this plant is that by Fernald *(69)* who calls it *A. rubra* forma *neglecta* (Gillman) Robinson. An excellent illustration of this baneberry is given in Stock-Poisoning Plants of Montana *(39, Pl. 28)*; the

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FIGURE 35.—Western baneberry [*Actea arguta* Nutt., syn. *A. spicata* var. *arguta* (Nutt.) Torr.].

authors of that work made experimental feedings of the plant to rabbits. Ordinarily it is not grazed by domestic livestock except where other forage is scarce. The plant has been reported as fair summer deer forage on the Allegheny National Forest (northwestern Pennsylvania), and it would be of interest to know whether such animals also utilize other baneberries.

Columbine (*Aquilegia*)

Columbines comprise a fairly large genus of closely related plants found naturally in Europe, North America, and Asia. They are perennial from more or less thick, woody, often perpendicular and branched roots, with erect stems varying from a few inches to 5 feet or so high, twice or thrice ternately compound leaves, and very characteristic, chiefly nodding flowers, blue, red, yellow or white (or tints or mixtures of those colors); the 5 sepals are colored and petallike; the inner 5 petals have a short "lip" and (with rather rare exceptions) are produced backwards into hollow "spurs"; the stamens are numerous, the innermost ones reduced to sterile *staminodia*. The 5 pistils ripen into a head of 5 erect, many-seeded follicles, or small "pods."

Aquilegia[27] has two excellent monographs, the North American species by Payson *(154)* and those of the world by Munz *(144)*. According to the conservative treatment of Munz there are 17 species and 14 varieties of columbines native to the Far West. However, two other species, **Hinckley columbine** ***(A. hinckleyana*** **Munz)** and **longspur columbine** ***(A. longissima*** **A. Gray)**, the latter with much the longest spurs in the genus, occur in extreme western Texas and neighboring Mexico; another, **Yukon columbine** ***(A. brevistyla*** **Hook.)** ranges as far south as South Dakota, and the eastern so-called **American columbine,** or **Canada columbine,** ***(A. canadensis*** **L.)** reaches westward to the Great Plains of Nebraska, Kansas, Oklahoma, and Texas. American columbine, according to Gilmore *(80)* was an important plant to certain Indian tribes as a love charm and medicine. This red-and-yellow-flowered plant, often cultivated as an ornamental, frequently grows on cliffs and other places difficult of access.

The genus has attracted considerable attention from students of plant genetics, cytology, and phylogeny. Stebbins *(189)* says:

> "*Aquilegia* has become a classic example of a genus in which isolating barriers between species are weak or absent * * * They are almost entirely allopatric; in a few places two species grow in the same region, but rarely, if ever, more than two, if we except regions which because of their great topographic relief include more than one climatic zone * * * The species are based almost entirely on differences in size, shape, proportions, and color of the sepals and petals."

[27]The traditional explanation of the scientific generic name is from Latin *aquila* (eagle), from a fancied resemblance of the curving flower spurs to an eagle's claws. A probably less accurate derivation is from Latin *aqua* (water) + *legere* (to collect), in allusion to the watery nectar at the bottom of the spurs. The common name columbine comes, through French and Medieval Latin, from the Latin adjective *columbinus* (like a dove, or pigeon, *columba*) and alludes to a certain resemblance of the upright spurs of a nodding columbine flower to a group of five doves, or pigeons.

Species of *Aquilegia* are among the most beautiful native western plants, and columbine has been suggested as an appropriate floral emblem of the United States. Every State and Alaska has at least one native species; the largely red, white, or blue flowers are handsome and the foliage graceful.

Columbines usually grow in moist situations such as shady streambanks, meadows, aspen groves, and open woods from the lower foothills to the high mountains. Some species appear on high, exposed rocky ridges and in sheltered canyons, seldom in pure stands, but more characteristically scattered.

As forage plants, columbines, though often large and leafy and sometimes abundant locally, are of but secondary importance. They rate in palatability as fair for sheep, poor for cattle, and practically worthless for horses. They are rather delicate plants and are likely to succumb if the range is depleted by overstocking, or other abuse, particularly if seeding is prevented. Due to past mismanagement, columbines have been greatly reduced on sheep ranges in Colorado where formerly they were plentiful.

Most species of columbine are in ornamental cultivation, but the modern, long-spurred columbines popular in gardens are chiefly hybrids or mutants *(10)*. The species most used in hybridization are probably our native **Colorado columbine** (***Aquilegia caerulea* James**) and **golden columbine** (***A. chrysantha* A. Gray**), the Mexican **Skinner columbine** (***A. skinneri* Hook.**), **Altai columbine** (***A. glandulosa* Fisch.**) of Siberia, and the **European columbine** (***A. vulgaris* L.**). The last named, a frequently cultivated blue-flowered species, is occasionally naturalized in this country. It has been reported as capable of producing symptoms in experimental animals very similar to the extreme prostration caused by aconite *(147)*.

Colorado columbine (***Aquilegia caerulea* James**)[28] (fig. 36) ranges from southwestern Montana and central Idaho south to eastern Utah and northern New Mexico. It occurs on the Kaibab Plateau of northern Arizona in the variety ***pinetorum* (Tidestr.) Payson** (syn. *A. pinetorum* Tidestrom), which usually has thrice ternate leaves with small leaflets and large, bluish, reddish, or whitish flowers with slender spurs 1½ to nearly 3 inches long. Colorado columbine is considered by many the handsomest of all columbines. It is especially abundant in Colorado and is the State flower, protected by law. This plant, important in horticulture, was introduced into cultivation in England as early as 1864.

The typical form of this rather variable species ranges in height, depending chiefly on site, from 8 to 32 inches. The leaves (mostly long-stemmed root leaves) are twice ternate (divided in 3's), the leaflets rather thin and large (mostly more than ¾ of an inch long) and usually bluish beneath. The flowers are large (specimens

[28]Discovered on the divide between the Platte and Arkansas Rivers, Colorado, and named by Dr. Edwin James (1797–1861), surgeon-naturalist. The specific adjective, meaning cerulean or sky blue, is often spelled *coerulea* but the digraph of the original publication of the name clearly indicates that James intended the *ae* form.

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FIGURE 36.—Colorado columbine (*Aquilegia caerulea* James).

5 inches wide have been reported), with a fine contrast between the spreading, deep to light blue sepals (up to 1½ inches long or more), the white or whitish blades of the petals (up to about 1 inch long), and the yellow stamens. The spurs are somewhat outcurved or straight, 1 to 2 inches long.

One of the variations, **white Colorado columbine** [***Aquilegia caerulea* var. *ochroleuca* Hook.**, syns. *A. caerulea* var. *albiflora* A. Gray, *A. leptocera* Nutt.] has white or somewhat cream-colored flowers. These plants bloom from June to August and occur in the mountains (between about 6,500 and 12,500 feet) up to and above timberline, frequently in moist meadows or on the edge of ponderosa pine, lodgepole, aspen, and other timber. Except under very favorable conditions the plants are not abundant enough to make up much of the vegetation and, ordinarily, the plant is not touched, especially by cattle, except for some nibbling of the flowers and tender leaves by sheep. On some ranges in Utah, however, the palatability for sheep has been reckoned as fair. However, such use may be associated with overgrazing or some other local condition.

The peculiar ***Aquilegia caerulea* var. *daileyae* Easterwood,** apparently confined to the Rocky Mountain National Park in Colorado, has spurless flowers.

Golden columbine (*Aquilegia chrysantha* A. Gray), a species of particular horticultural importance, ranges from central and southern Colorado south to New Mexico, Arizona, Chihuahua, and Sonora. The stems are solitary or few, branched above, 1 to 3 feet high (rarely shorter or taller), hairless *(glabrous)* except for a sticky hairiness in the inflorescence, perennial from a taproot with a thickened woody crown. The root leaves are usually thrice ternately compound, the leaflets broadly wedgelike *(cuneate)* at the base and scalloped *(crenate)* at the tip, ½ to 1½ inches long. The flowers are golden yellow, the petal blades 8 to 16 mm. (averaging about ½ inch) long, the spurs 1½ to nearly 3 inches long, the terminal nectaries knoblike and dark colored.

The plant is found in moist, often shaded sites in the foothills and in the ponderosa pine and aspen types in the mountains; often in canyons or along streams, about springs, seeps and pools of water, chiefly between 4,000 and 8,000 feet. Flowering period, depending on location, from late April to early August. The plant is hardly of sufficient abundance or palatability to have any particular range significance. Ordinarily it is eaten slightly, if at all, by sheep and goats and ignored by cattle. However, sheep sometimes exhibit a fondness for the flowers.

Westernred columbine (*Aquilegia elegantula* Greene) is distributed from western (chiefly southwestern) Colorado south into southeastern Utah, New Mexico, and northern Mexico. It is a rather small plant, averaging not more than 1 foot high, with single or tufted erect stems on the crown of a woody, usually branched and thickened root. The root leaves are twice divided into 3's—or 9 leaflets—*(biternate)*, the leaflets small, deeply 3 cleft, smooth, rounded, green above, and bluish beneath. Flowers

nodding, often solitary, the sepals short, sharp tipped, greenish or scarlet and yellow, the spurs scarlet, straight, about ½ to ¾ of an inch long.

Westernred columbine grows in the mountains, mostly between elevations of about 7,000 and 10,000 feet. It is found chiefly in moist rich soils of the ponderosa pine, Engelmann spruce, and aspen types, and often on the face of cliffs and in rocky canyons or on subalpine slopes. It flowers from May to August, but chiefly in June. Ordinarily the forage value of this plant is nothing to slight for sheep and goats. However, on a range on the Apache National Forest (Arizona) the palatability has been reported as poor for cattle and fair for sheep and goats. Wooton and standley *(214)*, recommend it for cultivation in gardens in the higher parts of New Mexico.

Yellow columbine [***Aquilegia flavescens* S. Wats.,** syn. *A. formosa* var. *flavescens* (S. Wats.) Hook. f.] occurs from British Columbia to eastern Oregon, Idaho, Utah, Colorado, Wyoming, and Montana. It has been collected on national forests at elevations as low as 1,775 feet in Washington and as high as 9,500 feet in Idaho. Typically the plants are smooth or nearly so, at least below, but in the dwarfed subalpine form (***minor* Tidestrom**) may be quite hairy. The thin leaves are twice (sometimes thrice) ternately divided; the flowers are nodding and wholly yellow or sometimes the sepals are red tinged, the petal blades *(laminae)* cream colored, the spurs shorter than the sepals.

Aquilegia flavescens is botanically close to *A. formosa*, but the petal blades are paler and longer (6 to 10 mm., *vice* 1 to 6, mostly 3 to 5 mm.), and the spurs are incurved instead of straight or nearly so. Ordinarily the palatability is none to low. This plant has been observed in some places to be moderately taken by elk; such nibbling of it by domestic livestock is chiefly by sheep.

Sitka columbine (***Aquilegia formosa* Fisch.**) is a perennial herb, mostly 20 to 40 inches high, which ranges from Alaska to California, New Mexico, Utah, Idaho, and Montana. Strangely, it seems to be absent from Colorado and Wyoming. The books indicate that it also occurs in Siberia, and Fischer's description points to Kamchatka as the type locality, but this would appear to be in error; the plant is wholly western North American, as Munz *(144)* and Hultén *(102)* have observed.

The species is found in the Sitka spruce type in Alaska, near sea level, at elevations from 500 to 7,500 feet in the Pacific States, and from 3,500 to 10,000 feet in the Great Basin area and Rocky Mountains. It is a common species in the aspen type and in openings in the lodgepole type, but it may be present in a great variety of soils and sites, sometimes being associated with sagebrush, ponderosa and Jeffrey pines, Douglas-fir, and white fir. It is especially at home along streambanks, about seeps, springs, and ponds, in meadows, canyon bottoms, and on moist wooded mountain slopes, particularly in loamy soils.

Sitka columbine has nodding, red, fairly large (about 1½ inches long) flowers, spreading or reflexed dark-red sepals longer than

the spurs, and relatively short yellow petal blades *(laminae)*. In its variety **California columbine** [***Acquilegia formosa* var. *truncata* (Fisch. & Meyer) Baker,** syns. *A. californica* Hartw., *A. truncata* Fisch. & Meyer], which ranges from southern Oregon, through California and western Nevada, to northern Lower California, the spur orifice has an abruptly cut off appearance *(truncate)*; the sepals and spurs are often yellow tinged, and the petal blades are very short (1 to 2 mm. long).

Sitka columbine and its variants form one of the most common, abundant, and widely distributed of western columbines; they are in bloom from late May or early June to August. As forage this species is of more value for sheep than for cattle, the palatability varying from worthless to fair or sometimes fairly good. It is of interest that the same observer on different areas of the same national forest will often express widely divergent opinions on the palatability of the species; evidently much depends on associated species, condition of the range, time of the year, and other factors.

Utah columbine (***Aquilegia scopulorum* Tidestrom**) is a small plant, 4 to 8 inches high, occurring from middle to subalpine elevations in the mountains of Utah. Reports have been made of its occurrence also in Nevada and southwestern Wyoming but they appear not to be thoroughly substantiated. The leaflets are crowded, 3/5 of an inch (15 mm.) long or less, the sepals pale blue to pale purple, the petal blades *(laminae)* white, and the slender spurs 1 to 2 inches long. It has been reported from southwestern Utah, where collected in a weed type near a stand of spruce and fir, as 50 percent palatable to sheep and goats. This probably reflects unusual conditions.

Marshmarigold *(Caltha)*

This genus, represented in the Far West by three species, is a group of smooth, more or less succulent perennials, with simple, long-stalked, kidney-shaped *(reniform)* or heart-shaped *(cordate)*, chiefly basal leaves. The regular flowers are showy, white, yellow, pink, or occasionally bluish, without petals and with about 5 to 12 petallike sepals, numerous short-stalked stamens, and pistils developing into clustered podlike fruits *(follicles)* splitting open on the back *(ventrally dehiscent)* when ripe to discharge the numerous seeds. The plants, when fresh, are very acrid and are normally distasteful to domestic livestock; probably all species are more or less poisonous in that condition. However, when dried, as in hay, they appear to lose this property and become harmless. They are sometimes cultivated as ornamentals.

Caltha is a classical Latin name for some strong-smelling, yellow flowered plant, and quite probably for the common marshmarigold *(C. palustris* L.), but most of the books indicate that the word means marigold which, to this writer, seems illogical, as marigold *(Tagetes)* is a New World genus unknown to the ancient Romans. The common name marshmarigold is hard to explain, because the plants do not resemble the marigold genus in the least. Another name in common use in this country for the genus is

"cowslip." The English "cowslip," a name familiar in literature, is **cowslip primrose (*Primula veris* L.)**, an entirely different plant.

Twinflower marshmarigold (*Caltha biflora* DC.) is a common inhabitant of high mountain marshes and wet meadows from Alaska to the Olympic and Cascade Mountains of western Washington and the Cascades of northwestern Oregon. Farther south, in southern Oregon, western Nevada and the Sierra Nevada of California, it is replaced by **Howell marshmarigold [ssp. *howellii* (Huth) Abrams,** syn. *C. howellii* (Huth) Greene], with solitary flowers and somewhat wavy-margined *(repand-crenate)* leaves. The leaves of twinflower marshmarigold are rounded-kidney-shaped, broader than long, about 1 to 3 inches wide; the naked flower stalks *(scapes)* are commonly 2, though sometimes 1 or 3, erect or nearly so, 2 to 10 inches high and longer than the leaves. Rather frequently, however, there is a leaf or leaflike bract on the stem near the summit, from the axil of which another flower may be produced, so that the stem, in such a case, is technically a *peduncle* from such leaf or bract upwards.

The 5 to 10 petallike sepals are of an oblong type, ½ inch long or so, white or somewhat bluish on the back, the stamens yellowish. The fruiting pods *(follicles)* have a distinctly stalklike *(stipitate)* base when ripe. The flowering period is late May or June into August. Ordinarily the plant is avoided by domestic livestock and the typical habitat is normally uninviting to sheep. This species is thought to have been responsible for the poisoning of 15 head of sheep on a national-forest range in Oregon.

Elkslip marshmarigold (*Caltha leptosepala* DC.) (fig. 37), often called "elkslip," occurs in high-altitude mountain bogs, about seeps and springs, along streambanks and the like, from Alaska to Alberta and Montana and south to Oregon and, in the Rocky Mountains, to New Mexico. In the large-orbicular-leaved **roundleaf marshmarigold [var. *rotundifolia* Huth,** syn. *C. rotundifolia* (Huth) Greene] it occurs in the Intermountain area and in the Blue Mountains of northwest Oregon.

The species is mostly stemless *(scapose)* except for the naked flower stalks; the leaves are heart shaped, longer than broad, and with a shallow sinus; the white flowers have 6 to 12 narrow, oblong to oblong-linear sepals.[29] It is the commonest and most widespread of the western marshmarigolds. Ordinarily this plant, which is sometimes locally very abundant, is not grazed by livestock if any other feed is available. The likelihood is that it possesses the toxic properties known to occur in other species of the genus.

Common marshmarigold (*Caltha palustris* L.), of Europe, Asia and eastern North America, gets as far west as Manitoba, South Dakota, and Nebraska, and is worthy of mention because of the enormous number of references to it in literature. It is a yellow-flowered species often cultivated as an ornamental. It has a considerable history as a stock-poisoning plant in Europe and contains

[29]The late Supervisor James C. Whitham collected a bluish-flowered specimen at 9,500 feet on the Gallatin National Forest (Montana) and stated that it represented the only ones of that color he had ever seen.

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FIGURE 37.—Elkslip marshmarigold (*Caltha leptosepala* DC.). Lower right, a cluster of fruits (*follicles*).

a toxic glucoside *(helleborin)* and an alkaloid *(jervin) (123, 141)*. It appears to be harmless when dried but is known to have poisoned and even produced death in cattle and horses and also to have poisoned human beings. Prominent symptoms of *C. palustris* poi-

soning are irritation of the stomach and the entire alimentary tract, vomiting, and bloody urine.

The plant appears to be innocuous or nearly so when it first comes up in the spring, the toxicity steadily increasing up to flowering and fruiting time. However, when the plant is cooked it is extensively used as a potherb. Fernald and Kinsey *(70)* speak of it as being "long * * * the most popular spring greens in New England." The stipules and mucilaginous leaf bases are first carefully removed and the herbage thoroughly boiled at least once and preferably twice to remove the acridity. It is then palatable and innocuous. The flower buds also are frequently pickled and used as a substitute for capers.

Bugbane *(Cimicifuga)*

This genus is worthy of mentioning from a range standpoint solely because of the known active chemical properties of some of its members. There are three western range species. **Tall bugbane (*Cimicifuga elata* Nutt.)**[30] is found from British Columbia south to Oregon, chiefly in the Coastal Range. **Cutleaf bugbane** or Mt. Hood bugbane (***C. laciniata* S. Wats.**) is confined to the Mount Hood area of Oregon. **Arizona bugbane (*C. arizonica* S. Wats.)** is known only from Coconino County, Arizona.

This is a group of spectacular tall perennial herbs, with large decompound basal and alternate stem leaves. The small white flowers are in terminal racemes or panicles; there are 2 to 5 free, usually petallike, nonpersistent sepals; usually an equal number of 2-lobed, clawed petals, numerous stamens with threadlike stalks *(filaments)*, and 1 to 8 pistils becoming in fruit an umbellike whorl of small pods *(follicles)*. The plants typically occur in moist sites, such as along or near streams and in rich woods. They appear to be unpalatable to domestic livestock. Frequently grown as ornamentals.

An eastern species, **cohosh bugbane [*Cimicifuga racemosa* (L.) Nutt.]**, known also as "black cohosh," "black snakeroot," and "richweed," is an official medicinal plant. Its thick woody roots contain *cimicifugin* which is used in the treatment of dyspepsia, rheumatism, and menstrual disorders. Country people deem is useful in the treatment of snake bite.

Giodthread *(Corptis)*

There are two species of goldthread on the western range. They are smooth, small herbs perennial from slender yellow bitter-tasting rootstocks *(rhizomes)*, whence another common name "yellowroot." The leaves are wholly basal and often suggest those of a strawberry plant, mostly being 3 lobed or parted or divided into 3 leaflets. Their flowers, solitary or few, are white, greenish or yellowish, with 5 to 7 petallike sepals, about the same number of narrow petals (or, according to some authorities, these are not

[30]The Latin generic name is based on the Old World use of the plant to kill bedbugs (*cimex*, bedbug + *fugo*, flee, or drive away).

petals but *staminodia,* or sterile stamens) and bear nectar pits at the middle or near the summit; the stamens are numerous, the 3 to 7 pistils becoming in fruit an umbellike cluster of stalked follicles containing smooth shiny seeds.

Cutleaf goldthread ***(Coptis laciniata*** **A. Gray)** grows in heavy moss-covered duff under Douglas-fir, western hemlock, and other coniferous timber from southwestern Washington to northern California and east into neighboring Idaho. It has glossy evergreen leaves, the three leaflets rather narrow and deeply cut or incised and sharp toothed. A forest supervisor in Idaho, who collected this plant (F.S. Herb. No. 2574) for identification, reported as follows: "I have found it very valuable for cattle. It is * ° ° found in greatest abundance in heavy stands of second growth red fir. It seems to root more in the duff and humus than in the mineral soil. Where cattle can reach it they will leave good bunch grass to feed on this plant." In a later letter he said: "We have found it to be of great value for fattening cattle on the range. It is greedily sought by stock."

Western goldthread [*Coptis occidentalis* (Nutt.) A. Gray, syn. *Chrysocoptis occidentalis* Nutt.], with the 3 leaflets 3 lobed to about the middle, occurs in moist wooded sites from British Columbia and Washington to Idaho and western Montana. Reported as abundant on three of the national forests in Montana and "grazed very extensively by cattle."

Common goldthread [*Coptis trifolia* (L.) Salisb.], the botanical type of the genus, although listed in Rydberg's Flora of the Rocky Mountains and Adjacent Plains *(173),* is hardly a range plant but perhaps should be mentioned because of its medicinal nature and the possible light it might throw on the chemical properties of its range congeners. It occurs in northern and montane Europe and Asia and, in North America, from Greenland to Alaska and south to British Columbia, Iowa, Minnesota, Indiana, and North Carolina. It is a moist woods or bog plant, with three evergreen toothed or shallowly lobed leaves.

It is not surprising that a plant of such wide distribution should be variable and that some botanists have preferred to put the Greenland, eastern North American, and possibly Alaskan plant in the subspecies *groenlandica* (Oeder) Hult. [syn. *Coptis groenlandica* (Oeder) Fernald]; Hultén *(102)* later considered that these variations hopelessly intergrade. The plant contains two alkaloids, *berberine* and *coptine,* and the rootstocks and whole plant are the source of an official drug used as a bitter tonic and for ulceration of the mouth, which recalls Warren B. Horner's blank verse Yellow Root: "Back in the hills where I was reared There was a kind of plant called yellow root. People chewed and gargled it For colds and sore throat; It had a bitter pucker in its juice That left grimaces for an hour * * *"

Larkspur *(Delphinium)*

Delphinium[31] is one of the larger and more important plant genera of this country. Ewan, whose treatment *(65, 67)* of the North American species is generally followed, attributes 61 species and 24 subspecies of larkspur to the 11 Far Western States. California, with 29 species and 12 subspecies, is the center of distribution; Oregon follows with 20 species and 4 subspecies; then, in order, come: Washington, 14 species and 5 subspecies; Montana and Wyoming, with 10 species and 4 subspecies each; Nevada, New Mexico and Utah, with 10 species and 3 subspecies each; Colorado, 9 species and 4 subspecies; Idaho, 9 species and 3 subspecies; and Arizona, 8 species and 4 subspecies. In addition, the annual Old World **rocket larkspur (*D. ajacis* L.)** is locally naturalized. Two larkspurs in Alaska are not found in the United States proper: **Browns larkspur (*D. brownii* Rydb.)**, a small plant, and **Chamisso larkspur (*D. chamissonis* Pritz.)**, a tall plant.

All our native larkspurs are perennial herbs. The occasionally naturalized rocket larkspur *(Delphinium ajacis* L.) is an annual. The native species either have a slender, somewhat evanescent stem from more or less tuberlike roots or the stem is stouter and more persistent either from a stout woody crown or from a rootstock with fibrous roots. The alternate leaves are palmately (like the fingers of the hand) ribbed, lobed or divided, usually either with 5 main divisions or else rounded, fanlike or kidney shaped and often with 3 lobes. The showy, blue, bluish, white, or in a few species, red flowers are usually in a terminal raceme, which may be loose or condensed, branching or narrow and spikelike and sometimes much branched and paniculate.

The calyx consists of 5 irregular colored sepals, the uppermost one produced backward into a spur; the petals, usually 4, are also irregular, the 2 lower ones with a slender claw produced backwards inside the spur, the 2 lower with a notched or 2-cleft blade usually of the same color as the sepals; there are numerous stamens and mostly 3 pistils sometimes fused into 1. The fruiting "pods" *(follicles)* are erect or spreading, with numerous small seeds. The leaves are often maplelike or currantlike and, before flowering, it is sometimes easy to confuse larkspurs with monkshood and wild geraniums. The spur of larkspur flowers is, of course, very different from the hood of monkshoods, while the latter have pithy stems instead of being hollow as in the case of larkspurs.

Larkspurs are common in the foothills and mountains in the Western States, chiefly occurring in well-drained loamy soil in

[31] *Delphinium* is derived from Greek *delphinion*, a name used for larkspur by Dioscorides Pedanius, celebrated 1st century B. C. Greek physician and herbalist. According to the manuals the word ultimately derives from *delphinos* (dolphin's) because of a supposed resemblance of larkspur flowers to a conventionalized dolphin. However, it seems not unlikely that Dioscorides was influenced in this nomenclature by the medicinal properties of an Old World larkspur and the fact that *Delphinios* was a common epithet of Apollo, the god of medicine. The common name larkspur, of course, originated in England, where the spur of the flower suggested the long spurlike claw on the hind toe of the male skylark (*Alauda arvensis* L.).

mountain parks, grasslands, sagebrush areas, and in clumps of aspen or in partial shade of other trees. The tall larkspurs often reach their greatest development and abundance at the higher elevations in rich, moist loamy soils along creek banks, in the heads of valleys, in high basins or on gentle slopes usually in more or less shaded sites and frequently as the undergrowth of open aspen or conifer timber. The plants sometimes occur as more or less scattered individuals over large areas but are frequently in dense, rank stands up to several acres in extent. The low larkspurs are usually more abundant at the lower altitudes of the mountain ranges in the more open and exposed types. They are characteristically seen as quite widely scattered individuals; however, sometimes they are of sufficient abundance to constitute a material amount of the vegetation. Due to the wide range of elevations within which larkspurs grow, there is a great difference in the time of their growth and development.

Generally larkspurs are among the very first plants of the habitat to commence growth in the spring. During the early part of the season, the large, light green bunches of tall larkspur are very conspicuous above the associated species. These plants begin flowering as early as June and often continue well into September. The low larkspurs usually bloom in May or June and soon after mature, dry up, and largely disappear. Their blue flowers are often very noticeable as they appear above the other vegetation early in the growing season.

Larkspurs probably represent the most important poisonous plants to cattle of any occurring on the high summer ranges of the West, although the locos are generally considered to take first place among stock-poisoning plants for the West as a whole. Horses may be poisoned by larkspur, but losses are rare since they seldom eat the plant in quantity sufficient to cause serious consequences. While many larkspurs are known to be poisonous to cattle, it is questionable whether all species are poisonous *under range conditions*. However, it is the safest policy to regard them all as suspicious pending full knowledge concerning them.

The greatest loss of cattle occurs during the early spring and summer, because larkspur produces an abundance of forage in advance of other plants and begins growth on the higher summer ranges soon after the snow melts. This group creates a serious problem in managing cattle on the range, because so many larkspurs are poisonous both before and after blooming. Under range conditions sheep are seldom poisoned by larkspur, and it is common for sheep to utilize larkspur areas, the palatability for sheep often being good.

Beath *(12)* voices the opinion that "larkspur in full bloom is not very poisonous to sheep due to the fact that the water content of the plant is lower, and also because the poison becomes less soluble in water as the season advances, so that sheep grazing on the young larkspur are liable to become poisoned, and especially if the plants are moist * * * Young larkspur is eight times more poisonous than the mature growth. The poisons isolated at this [Wyo.

Agr. Expt.] station from young larkspur and from larkspur in full bloom clearly prove the above statement."

All parts of larkspur plants are poisonous *(129)*, but it is usually the leaves, stems, and flowers that are taken by cattle. The seeds are very poisonous but are seldom eaten. The low species continue poisonous throughout their whole life period while the tall ones partly lose their toxic properties after blossoming *(134)*. The most danger from both forms occurs during the early part of the season chiefly because they make up such a comparatively large and the most succulent part of the vegetation at that time of year.

In the treatment of poisoned animals Marsh, Clawson, and Marsh *(135)* report that beneficial results usually are obtained by injecting a solution of 1 grain physostigmin salicylate, 2 grains pilocarpin hydrochloride, and ½ grain of strychnine sulfate, with a hypodermic syringe, preferably in the shoulder. The above amount dissolved in approximately 1 tablespoon of water is the proper dose for an animal weighing 500 to 600 pounds. The formula should be doubled for an animal of 1,000 pounds. The syringe used in administering blackleg vaccine will serve.

Numerous larkspur-eradication projects have been conducted in the West, particularly with Barbey larkspur *(Delphinium barbeyi* Huth) and Sierra larkspur (*D. glaucum* S. Wats.). Eradication has been attempted both by grubbing and chemical means. In grubbing larkspur special care must be exercised to assure that all plants, including the seedlings and other small specimens, are dug. It is imperative that enough of the root system be removed to prevent the remnant from sprouting. This implies grubbing every larkspur plant discernible and removing the roots to a depth of not less than 8 inches, including all side roots as well as the base of the plant.

Workmen must make sure that no roots grubbed fall back into the hole and that all dirt is shaken from them to prevent possible regrowth. It is outstandingly important to burn all plants after removal to prevent their consumption by cattle. Regardless of the care exercised in digging Barbey and other larkspurs, it is always necessary to go over the area the following year to remove any plants that have been missed. Usually a second follow-up is necessary to eradicate plants developing from seed stored from previous seasons *(3)*.

Spraying with sodium chlorate in neutral, acid, or alkaline solutions of 2½ percent or more and upwards during the active growing period of larkspur is effective but risky because of the flammability of this chemical and its toxicity in quantity to livestock *(53)*. A salty taste increases its attractiveness and encourages consumption of treated plants. Calcium chlorate, while less effective than sodium chlorate, has also been successfully used in chemical eradication of larkspur and has the advantage of being neither poisonous nor flammable. These soluble chemicals are easily applied, kill both tops and roots of the poisonous plants and thus prevent sprouting. The addition of a little whale-oil soap of glycerine facilitates the uniform distribution and retention of the

solution upon the leaf surfaces. More recently, 2, 4-D and 2, 4, 5-T have been partially successful in killing larkspur and, at the present time, of course, research in developing new weedkillers is very active.

Horticulturally, larkspurs rank among the most important of herbaceous perennial ornamentals. The American Delphinium Society publishes an ornate journal, its "Bulletin." The literature on these plants is enormous; among the most important works are those by Bailey *(9)*, Bishop *(23)*, Leeming *(117)*, Phillips *(156)*, and Wilde *(210)*. The ripe seeds of the Old World **stavesacre larkspur** ***(Delphinium staphisagria* L.)**, containing various alkaloids including *delphinine, staphisagrin,* etc., are an official drug used in pediculosis and as a heart depressant.

Larkspurs are popularly divided in range country into two categories: Low (and more or less evanescent) larkspurs, and tall larkspurs. However, there are many species of an intermediate character and, for convenience, the 14 species annotated here are placed in three categories: Low, medium, and tall.

Low Larkspurs

(Average height: less than 1 foot)

Here belong a group of larkspurs of low stature, often with tuberous roots and weak stems, which come up early in the spring and frequently dry up and disappear early in the season—whence called "spring" larkspurs. These larkspurs can cause heavy losses of cattle on spring and early summer ranges. They are often grazed moderately by sheep and cattle but very seldom by horses. No known losses of horses have occurred on the range from "spring" larkspur poisoning, and the suspected sheep losses reported here under slim larkspur appear to be the only ones recorded for that class of livestock.

These species are more palatable to sheep than to cattle and are especially likely to be grazed extensively when little other feed is available. Sheep generally prefer grasses and other weeds to the low larkspurs, and on some ranges in Idaho and Nevada these "spring" larkspurs are regarded as unpalatable to livestock. Due to the early seeding and subsequent dying down of the true "spring" larkspurs (i.e., those which, like *Delphinium depauperatum* and *D. nuttallianum*, have low weak stems tapering to a hair-like point above the roots) on the range, it is usually safe to graze cattle after the first of July on areas that produce large quantities of these species, unless normal plant development is delayed by unfavorable weather or other conditions. The following species are characteristic of this group.

1. **Little larkspur** ***(Delphinium bicolor* Nutt.)** (fig. 38) occurs from British Columbia, Alberta, Saskatchewan, and North Dakota to the Black Hills of South Dakota and south to Wyoming (apparently not in Colorado), Utah, Nevada, and Oregon (apparently not in California). It is found on medium-dry to moist sites on plains and in the mountains but grows best in rich black sandy

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FIGURE 38.—Little larkspur (*Delphinium bicolor* Nutt.). Dissection of corolla and cluster of fruiting follicles at right.

loams where there is sufficient moisture. It occupies soils of both limestone and granitic origin, in sunny weed types or open, partly shaded timber, and at elevations from about 3,000 to nearly 10,000 feet.

The plant is about 4 to 14 inches high, more or less fine-hairy at least above, perennial from an elongated, slender, woody-fibrous taproot. The leaves are few and spreading, basal or nearly so, varying in outline from kidney shaped to rounded. The flowers are large, the sepals unequal, the two small upper petals white or pale yellowish with purple lines—whence the scientific name *bicolor*. The plant is variable and at least three forms or varieties are recognized. It is one of the earliest appearing wild flowers, frequently blooming at the edge of snowbanks in the mountains.

On many ranges little larkspur is relatively abundant, and during the early spring it forms a very conspicuous part of the vegetation. Because all parts of the plant are quite toxic to cattle, its extensive use results in some losses of that class of livestock, especially in Montana, where the species is rather plentiful. Feeding experiments with sheep did not produce fatal results, and under range conditions little larkspur apparently is not poisonous to that kind of livestock *(134, 135)*; in fact, the plant is usually considered fairly good sheep forage. It is possible, of course, that bad results could follow if very hungry sheep, after being driven some distance, were allowed to gorge themselves in an extensive patch of the plant. Fortunately, cattle losses are easily preventable by prohibiting entry of those animals to infested ranges until the plant, which matures early, has dried up or until more palatable forage is available.

The plant blooms in May and June or, at the higher elevations, this may extend to July and early August. Being perhaps the most beautiful of the small American larkspurs, this species is frequently cultivated as an ornamental. Early settlers in the West commonly used the seeds of this species as poison for exterminating lice and other vermin.

2. **Yellowtinge larkspur (*Delphinium decorum* Fisch. & Mey.)** is an essentially coastal or near-coastal California plant, low but rather stout, mostly 3 to 7 inches (rarely 12 inches) high, perennial from a cluster of fleshy tuberous roots, and occupying open grassy slopes, ravines, and woodland-chaparral types. It was originally collected in the Bodega Bay area of Sonoma County in a then Russian colony. Fischer (1782–1854) and Meyer (1795–1855), the authors of the species, were Russian botanists.

In the **ssp. *tracyi* Ewan, *Tracy larkspur*,** the species extends to Josephine County, southwestern Oregon. The stems of typical *D. decorum* are more or less beset with crisp white hairs; the flowers appear March to June. The subspecies *tracyi* differs from typical *decorum* in having a different range (more in the Inner Coast Ranges than maritime), in having the leaves more or less palmately dissected (instead of 3 parted), the primary divisions again divided (instead of entire or nearly so), and the stems are smoother.

Delphinium decorum is frequently confused with **spreading lark-**

spur [*D. patens* Benth., syn. *D. decorum* var. *patens* (Benth.) A. Gray] and vice versa, a California species with about four well-marked subspecies. It is a more typically montane (Sierra Nevada, etc.) California species, growing in grass, sage-juniper-weed, ponderosa pine, and aspen-willow types between elevations of about 1,000 and 8,000 feet, often with an elongated taproot, and differing chiefly in being slim stemmed; the flowers more numerous (6 to 15, instead of 1 to 5 or rarely 6 to 8) in the raceme; the 3-parted leaves larger (4 to 9 cm., instead of up to 4 cm. wide), and the upper petals *not* mitten shaped (i.e., without a distinct subapical lower lobe). *D. patens* is considered poisonous to cattle if eaten in quantity.

3. **Slim larkspur (*Delphinium depauperatum* Nutt.),** one of the smallest of American larkspurs, was originally known from the Blue Mountains of northeastern Oregon and ranges from British Columbia and Alberta to California, Nevada, and Idaho. It is perennial from a short, vertical rootstock or irregularly almost tuberous roots; the slim, delicate, often reclining stems are 2½ to 6 or occasionally as much as 14 inches high and unbranched, disarticulating above the roots. The thin leaves are few (1 to 3), small, often less than 1 inch though sometimes 2½ inches wide, the outline somewhat fan or kidney shaped, divided into 3 to 5 main divisions *(pedately palmatifid)*. The small dark blue flowers have a disproportionately long spur (8.5 to 15 mm. long) and are few in number (1 to 7) in the raceme. The fruiting pods (follicles) are smooth, erect, about ½ inch long.

Slim larkspur is one of the earliest to appear in the spring, flowering from May to August, and fruiting August to October (depending largely on site conditions). It occupies a great variety of sites, including dry meadows, lake and stream beds, deep rich loams, weed, sagebrush, juniper, conifer and aspen types at elevations from 1,000 to 9,000 feet. Its palatability to sheep varies from low to fairly good.

On the Challis National Forest (Idaho) it is reported that cattle are occasionally poisoned by slim larkspur but, even more, by tall larkspur, which is locally abundant. In many places cattle appear to avoid the plant. It was observed to be occasionally eaten by deer on the Sequoia National Forest (California). Slim larkspur was collected on the Colville National Forest (northeastern Washington) in an area where sheep losses occurred. And on an area at 8,500 feet elevation on the Wallowa National Forest (northeastern Oregon) where many sheep died from poison, no other poisonous plant than this could be found.

These reports are of interest in view of published statements to the effect that range sheep or horse losses from low, or "spring" larkspurs are unknown *(134, 135)*. Two larkspurs frequently confused with slim larkspur are Columbia and Nuttall larkspurs. **Columbia larkspur (*Delphinium nuttallii* A. Gray,** syn. *D. columbianum* Greene) occurs in the lower Columbia River valley of Washington and Oregon and was originally collected by the famous naturalist and explorer Thomas Nuttall in 1834 "along and near the

Columbia River above The Dalles;" it grows erect from a rounded tuber, is 16 to 24 inches high, fine-hairy, and has a spikelike inflorescence of dark blue flowers. **Nuttall larkspur [*D. nuttallianum* Pritz.,** syn. *D. pauciflorum* Nutt., *not* D. Don *nor* Reichenb.] ranges from British Columbia to California, Nevada, Utah, Wyoming, Montana, and Idaho. It has a slender weak stem 5 to 12 or sometimes 18 inches high and a cluster of tuberlike roots. It is very close botanically to *D. depauperatum* but averages taller and has larger and nodding flowers, the sepals averaging 7.5 mm. (instead of 5 to 8 mm.) long. More information is needed about the values of these two species, but they appear to be about the same as those of *D. depauperatum.*

4. **Menzies larkspur (*Delphinium menziesii* DC.)**[32] (fig. 39), also known as "spring larkspur," as now received *(65)* has a rather restricted range, in Vancouver Island, British Columbia, eastern coastal Washington, and the islands of Puget Sound. It is not in Oregon except in the subspecies ***pyramidale* Ewan,** which tends to be a stouter plant, the upper part hoary or glandular-hairy, the leaves larger and thicker, the lower flower stalks *(pedicels)* longer, more (12 to 20) flowers, and the fruiting pods *(follicles)* more spreading.

Menzies larkspur is a small plant perennial from a rather shallow cluster of tuberous roots. The stems are soft-pubescent with spreading white hairs at least in the upper part; the palmately cleft or divided leaves vary considerably in shape and size but tend to have wedgelike divisions; the blue flowers are usually few (5 to 10) and rather large and showy, the sepals 10 to 17 mm. (½ inch or more) long, the spur rather thick, the fruits *(follicles)* tending to spread when ripe.

Published and other economic observations on Menzies larkspur are usually more or less confused with the related little larkspur *(Delphinium bicolor)* and particularly with **Nelson larkspur *(D. nelsonii* Greene),** a far more widely distributed species named in honor of the late Prof. Aven Nelson of the University of Wyoming. Nelson larkspur ranges from Oregon, Idaho, western Montana, and the Black Hills of South Dakota to Wyoming, Colorado, Utah, and Nevada. Apparently it is absent from Washington and California but, in the form ***pinetorum* (Tidestrom) Ewan** (syn. *D. pinetorum* Tidestrom) it occurs in Arizona; that form is more dwarf (mostly 4 to 6 inches—rarely 14 inches high), with small gray, ashy-hairy leaves up to ¾ of an inch wide "having a collapsed appearance," and smaller flowers; it is found in the ponderosa pine and lodgepole pine types of Arizona and Colorado.

Typical Nelson larkspur differs from typical Menzies larkspur largely in having smoother stems (thinly puberulent or almost hairless in the inflorescence), in having smaller, scarcely showy

[32]The species commemorates Archibald Menzies (1754–1842), surgeon-naturalist with Capt. Vancouver, who discovered and collected the plant in the 1790's "in Nova-Georgia"—presumably in the Straits of Georgia area (between Vancouver Island and the coast of southwest British Columbia and perhaps extending into the upper Puget Sound region).

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FIGURE 39.—Menzies larkspur (*Delphinium menziesii* DC.). Individual flower (opened), cluster of follicles, and individual leaf at right.

flowers (the sepals 11 to 15 mm. long) and with usually more than 10 in the racemes. It resembles Menzies larkspur in having a cluster (though usually fewer) of tuberlike roots and the sepals nearly equal, both differing from little larkspur, which has slender, more or less elongated and woody-fibrous roots, and the sepals distinctly unequal in size.

Nelson larkspur is typically a plant of the mountains, growing at altitudes from 2,000 feet or so in northern Idaho and other more northern parts of its range up to elevations as high as 10,500 feet in the Rocky Mountains, especially the more southern part. The species grows in numerous associations, in aspen, lodgepole pine openings, and in the sagebrush, oakbrush, and ponderosa pine belts, but is especially characteristic of open grass-weed-brush areas. Frequent associates are lupines, bluegrasses, wheatgrasses, and rabbitbrushes. It inhabits a variety of soils—dry to moist, shallow and sandy, gravelly, or rocky, to deep rich loams or heavy clays.

Medium Larkspurs

(Average height: about 15 to 25 inches)

This is an artificial and arbitrary group, averaging somewhat midway in size between the low, or "spring" larkspurs, not evanescent and too small to be included in "tall" larkspurs. Of course, individual intergrades occur. The species annotated here are representative of this group.

5. **Anderson larkspur (*Delphinium andersonii* A. Gray)**[33] ranges in dry to medium moist sites from central and southern Oregon to California, Nevada, Utah, and Idaho. Its altitudinal range is mainly between about 4,000 and 8,000 feet, often in gravelly or rocky loams, on brushy "desert" flats, in sagebrush types and somewhat alkaline mountain valleys. It is an erect, rather stout perennial, from a wide-spreading, woody-fibrous rootcrown; the stems are single or few, rather brittle, smooth, often shiny, straw-colored to bluish or purplish, 8 to 24 inches high. The leaves are mostly in a basal tuft, the main divisions often overlapping or crowded.

The inflorescence is crowded, usually 5 to 10 flowered, short but elongating in fruit; the flower color varies from blue or purplish to whitish, the thick spur usually shorter than the other sepals. The fruits *(follicles)* are from a little over ½ to a little over 1 inch long. The flowering period is mainly from early May to early July. The palatability of this species to sheep is ordinarily rated fairly good. On overgrazed range in the Intermountain Region, it is one of the chief causes of early spring losses of steers and cows. The Nevada Agricultural Experiment Station issued a special bulletin

[33]The plant commemorates its discoverer, Dr. Charles Lewis Anderson (1827–1910), a physician of Minneapolis, Minn., Carson City, Nev., and, later, Santa Cruiz, Calif. One of his hobbies was botany, and many western plants bear his name. A biographical sketch of Anderson, with portrait, by Prof. Jepson, appeared in Madroño 1: 214–216. 1929.

on the plant, with a colored plate, and notes on its occurrence, characteristics, symptoms of poisoned animals, etc. *(73)*.

6. **Slender larkspur (*Delphinium diversifolium* Greene)** was originally described from "mountains about the headwaters of the Humboldt River in eastern Nevada" and has been much confused in the books with *D. depauperatum* Nutt. and *D. nuttallianum* Pritzel, two small, chiefly Northwestern larkspurs. The typical form occurs in subalpine meadows and on slopes and ridges between about 8,000 and 10,000 feet in the Ruby Mountains of Nevada, but in the subspecies ***harneyense* Ewan,** which averages a few inches taller and has broader leaves and larger flowers, it extends into Oregon, Idaho, and California.

This is a very slender, often bluish *(glaucous)* plant from a slim, spindle-shaped root, the leaves few, basal or nearly so and deeply 3 cleft; in the typical form it is seldom over 14 inches high; the blue flowers have slender spurs about ½ inch long; the fruiting pods are straight, erect, and glandular-hairy. Slender larkspur occurs in both moist and dry sites. The subspecies *harneyense* has been reported to be most toxic to cattle when the ground is damp enough for them to pull the plant up by the root.

7. **Orange larkspur (*Delphinium nudicaule* Torr. & Gray)** occurs from southwestern Oregon to California, chiefly in the Coast Ranges from the Siskiyous to Marin and Santa Cruz Counties and also in the Sierra Nevada but "rare." It has an elongated, rather thin and vertical, not fleshy rootstock, free from pubescence or slightly hairy, the stem 6 to 30 inches (rarely 3 feet) high, often bluish *(glaucous)* and somewhat swollen *(fistulous)*.

The inflorescence is a loose, open, 2- to 12-flowered raceme, the flowers typically orange red—sometimes red—but usually more or less tinged with greenish or orange, 1 to 1¼ inch long, including the usually straight spur, which is nearly half again as long as the other sepals. The fruits are mostly smooth, divergent-curving, ½ to 1 inch long, somewhat narrowed at the base. The plant occurs mainly between elevations of about 900 and 6,000 feet, in both dry sandy-gravelly-rocky and rich humus soils, flowering from March to July. In general the palatability appears to be low.

Orange larkspur is reported to be poisonous to cattle on the Klamath National Forest (California). It is also reported to have narcotic and soporific properties and to need scientific study *(151, 180)*. Chesnut *(38)* mentions that the Calpella Indians call this species "Soma yem," which means "sleep root," and that they use it to cause an opponent to become stupid while gambling. In Sonoma County, California, at lower elevations, occurs the related **Sonoma larkspur (*D. luteum* Heller).** It is a smaller plant, with no or fewer stem leaves, and cream-colored flowers. Some botanists place it under the varietal name *luteum* (Heller) Jepson.

8. **Barestem larkspur (*Delphinium scaposum* Greene)** inhabits Arizona and New Mexico and occurs northward to southwestern Colorado, southern Utah, and Nevada. It is 8 to 24 inches high, smooth or finely pubescent, from a slender, often elongated and branching, woody rootstock often with numerous fibrous roots.

The herbage is pale green, the mostly three-lobed leaves mainly basal, giving the *scapose* (leafless-stemmed) appearance referred to in the scientific name. The flowers are a rich or dark blue, about an inch long, with an incurved spur. The fruiting pods *(follicles)* are usually three and erect. It is found on dry gravelly-rocky foothills, in grama-weed, sagebrush, juniper and ponderosa pine types, on cinder plains, dry arroyos, limestone rocks, decomposed granite, and other sites of rather limited moisture.

Barestem larkspur has been collected on national forests between elevations of about 2,000 to 8,000 feet. The flowering period is mainly late March through June. This plant is rather common within its range but, in general, its palatability appears to be negligible to low. It has been reported as poisonous to cattle on two national forests though no actual losses have been indicated. The species is not known to be in ornamental cultivation, but it is a handsome plant, the pale stem, light green leaves, black root, and rich blue flowers being in striking contrast.

9. **Wright larkspur (*Delphinium scopulorum* A. Gray)** (fig. 40)[34] is a medium-sized species of New Mexico and Arizona. Unfortunately it has been confused in the past with **thickspike larkspur [*D. stachydeum* (A. Gray) Tidestrom,** syn. *D. scopulorum* var. *stachydeum* A. Gray] a much larger plant with an entirely different range (Oregon-Idaho) and, from this fact, the misleading common name "tall mountain larkspur" has been applied to *D. scopulorum.*

Wright larkspur has a slender, ashy-puberulent stem 16 to 36 inches tall, the leaves often *dimorphic,* i.e., of two types, the root leaves broadly and palmately divided with few lobes or teeth and the stem leaves finely dissected; the flowers are medium blue, in usually short and few-flowered racemes. It usually grows in gravelly or rocky clay loams, in grass-weed, park, oakbrush, ponderosa pine or alpine types, at elevations between about 6,000 and 12,500 feet. Its palatability on the Apache National Forest (Arizona) has been rated as zero to poor or at most fair for cattle and fairly good to good for sheep. This species has been reported as poisonous to cattle and to sometimes cause losses if eaten in quantity.

Tall Larkspurs

(Average height: 3 feet or more)

10. **Barbey larkspur [*Delphinium barbeyi* Huth,** syns. *D. attenuatum* M. E. Jones, *D. cockerellii* A. Nels., *D. scopulorum* var. *subalpinum* A. Gray, *D. subalpinum* (A. Gray) A. Nels.] (fig. 41)[35]

[34]The species was discovered by Charles Wright (1811–85), the distinguished American plant explorer (especially of the Southwest, so far as the United States is concerned), on whose collections Asa Gray based his book *Plantae Wrightianae* and about whom is a chapter in Geiser's *Naturalists of the Frontier.*

[35]Barbey larkspur was named by the German botanist Ernst Huth (1845–97), monographer of the genera *Caltha, Delphinium,* and *Paeonia,* in honor of the Swiss botanist William Barbey (1842–1914). Barbey was responsible for letting Huth see Penard's Colorado type specimen on which *Delphinium barbeyi* was based.

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FIGURE 40.—Wright larkspur (*Delphinium scopulorum* A. Gray).

is one of the most important and abundant, and more widely distributed, tall larkspurs. It is typically a plant of the higher mountains, ranging mostly from about 8,000 feet up to or above timberline at about 11,500 feet, but occasionally as low as 6,000

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FIGURE 41.—Barbey larkspur [Delphinium barbeyi Huth, syns. *D. attenuatum* M. E. Jones, *D. cockerellii* A. Nels., *D. scopulorum* var. *subalpinum* A. Gray, *D. subalpinum* (A. Gray) A. Nels.]. Dissected flower at upper right; head of follicles at center right.

feet toward the northwestern limits of its range. The species appears to be chiefly confined to three States, Wyoming, Colorado, and Utah, but it occurs also in neighboring southern Idaho and northern New Mexico. Large patches of this tall larkspur may be found growing abundantly along streams, in canyons and on moist, well-drained soils, chiefly in aspen-weed-grass, subalpine fir and spruce-fir types.

Barbey larkspur has a stout woody rootstock; stout, hollow, straw-colored stems, more or less glandular-hairy at least above, up to 8 feet tall, occasionally as low as 20 inches; leaves broader than long, palmately divided into 3 broad primary segments; dense and short racemes of showy, scented flowers, the sepals rich purplish with spur nearly ½ inch long and hooked at the tip, the upper

petals edged with white or yellowish white, the fruits *(follicles)* bluish-purple-veined, with smoky-brown seeds. The flowering period is mainly July and August.

It is easy to distinguish Barbey larkspur after it blossoms, because no other plant in its habitat has similar flowers. However, these plants in the early stages of leaf and stem growth are often confused with sticky geranium *(Geranium viscosissimum* Fisch. & Mey.), a harmless, widely distributed and common range plant, and also with monkshood, particularly Columbia monkshood *(Aconitum columbianum* Nutt.).

The leaves of sticky geranium are mostly basal and long stalked —those that do occur on the stem being paired—while the stems of Barbey larkspur are very leafy, are not paired, and are shorter stalked. The leaves of monkshood are are similar in shape, size, and arrangement to those af Barbey larkspur, but are somewhat shorter stalked; the stems of monkshood are pithy as a rule, while those of larkspur are usually hollow; the roots of monkshood are tuberous and often clustered near the soil surface, while those of Barbey larkspur are enlarged, woody, and deep; the well-developed hood of the monkshood flower and the marked spur of the larkspur are very distinctive.

Probably the most serious cattle losses from tall larkspur poisoning throughout its known western range is caused by Barbey larkspur, and the species has been the basis of much experimental work. The stored food in the large and deep woody taproot of this and other tall larkspurs facilitates the rapid growth of leafy stems early in the spring before many edible but harmless plants have made an appreciable start. Growth of as much as 1 to 2 feet in May has been reported, but the rapidity of development varies greatly according to the altitude and moisture and temperature conditions.

The large leaves are more poisonous than the stems and are most toxic when the plants are starting spring growth. Their poisonous properties tend to decrease as the plant matures in July and August. In fact, cattle often graze without harmful effect the palatable green leaves that persist after the plant has seeded *(135)*. The leaves remain palatable until killed by frost. Although the roots also contain the toxic principles, their woodiness and deep underground habit of growth render them almost inaccessible to cattle.

The seeds of Barbey larkspur are very poisonous and have occasionally caused some losses. Perhaps this situation may be responsible for a report from a Utah national forest that the plant is "very dangerous after frost," and that it "kills sheep after frost has hit it." Although this species, if eaten in sufficiently large quantities and within a comparatively short time, may cause sheep poisoning, range fatalities seldom, if ever, occur, except possibly under badly overgrazed or other very abnormal conditions. Horses may be poisoned experimentally by this species but, under range conditions, this kind of livestock apparently never eats enough of

this larkspur to be injured. In most instances infested ranges may be used with safety for pasturage of sheep and horses.

11. **Sierra larkspur [*Delphinium glaucum* S. Wats.,** syn. *D. scopulorum* var. *glaucum* (S. Wats.) A. Gray] (fig. 42) derives its common name from the fact that it is abundant and conspicuous in the Sierra Nevada Mountains and was discovered there. It is now known to range from Washington to California and neighboring Nevada. The huge larkspur of Alaska and Yukon and which sometimes reaches a height of over 9 feet, called *Delphinium glaucum* by Hultén *(102)* and others, is considered by Ewan *(65)* to be a different species, ***D. brownii* Rydb.**

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FIGURE 42.—Sierra larkspur [*Delphinium glaucum* S. Wats., syn. *D. scopulorum* var. *glaucum* (S. Wats.) A. Gray]. Dissected flower at upper right, with group of follicles below.

Sierra larkspur is a large, leafy, showy plant, commonly from 3 to 7 feet in height, with sometimes as many as 20 stems from the broad woody crown. The stems are smooth and hairless except sometimes in the inflorescence, and the herbage is more or less bluish *(glaucous)*—whence the scientific name. The ultimate leaf divisions are jagged and sharp, the large lower leaves as much as 6 inches across and 5 to 7 lobed.

The flowers are a deep blue with the spurs straight or nearly so. The hairless, straw-colored seed pods *(follicles)* are straw-colored, smooth and shining, erect, up to ¾ of an inch long, with broadly winged and shiny seeds. It is typically a plant of high elevations, between about 6,000 and 9,000 feet in the Sierra Nevada and 4,000 to 6,500 feet in Washington and Oregon. It is characteristic of wet meadows and streambanks but occurs on slopes where there is sufficient moisture and/or shade.

Sierra larkspur is poisonous to cattle and horses, but apparently is not injurious to sheep, for which its palatability is fair to fairly good or good. Although all parts of the young plants, except possibly the flowers, are poisonous, these toxic properties tend to disappear subsequent to the blooming stage and maturity. Unfortunately, cattle often relish Sierra larkspur in the early spring, when the young and succulent plants are particular toxic and other forage is scarce. Accordingly, the practical method of preventing losses is to prohibit this kind of livestock from grazing infested areas until late summer, when this larkspur is no longer harmful.

The early symptoms of poisoning are similar to those produced by deathcamas—the animal's muscles stiffen and the gait becomes irregular; later, the front legs give away, and the animal falls, usually with muscles quivering. The animal kicks violently before death ensues. Poisoned animals become constipated, but usually recover if this condition is relieved. Bloating occurs in some cases. When the poisoning is sufficiently severe to produce fatal results, death ordinarily follows in a very short time *(135)*. In the treatment of larkspur poisoning, the animal's head is kept higher than its body and all unnecessary exercise prohibited. A formula for an injection that is recommended for use in treating affected animals is given on page 173.

12. **Duncecap larkspur** [***Delphinium occidentale* S. Wats.,** syns. *D. abietorum* Tidestrom, *D. multiflorum* Rydb., *D. reticulatum* (A. Nels). Rydb.], including its 2 subspecies, is found in the higher mountains (about 5,000 to 11,000 feet) in all of the 11 Far Western States except California and Arizona. The species inhabits a variety of soils, dry shallow gravels and sandy clays but does best in rich black loams, along streams, about springs, in moist meadows and the like, in both open and shaded sites; it is common in aspen patches. The flowering period is mainly July and August.

Duncecap larkspur is commonly 3 to 6 feet high from a deep vertical woody root; the stems are mostly straw colored below and often darker bluish above; the strongly ascending, often long-stalked leaves are palmately divided, somewhat as a currant leaf, into 3 to 5 main divisions. The relatively small flowers are in

dense terminal racemes, which are rather spikelike at first but later become more open and branching, the stem *(rachis)* often glandular. The narrowness of the flowers and pointed spurs resemble a duncecap—whence the common name.

The subspecies ***cucullatum*** **(A. Nels.) Ewan** (syn. *Delphinium cucullatum* A. Nels.) has a somewhat more northern range, is never densely hairy; has a more simple raceme, and the sepals are white in front, contrasting with the blue spurs and the 2 upper pale blue sepals, the 2 lower sepals also being white. The smaller, more hairy, blue-sepaled subspecies ***quercicola*** **Ewan** (syn. *D. quercetorum* Greene, not Boiss. & Hausskn.) extends the range of the species into New Mexico, from which State the typical form appears to be absent.

The palatability of duncecap larkspur to sheep is, in general, good, the leaves and flowers being picked off; for cattle the palatability is fair to fairly good. Heavy cattle losses from this species have been reported from the White River (Colorado) and Humboldt (Nevada) National Forests. The subspecies *cucullatum* was the tall larkspur used by Marsh and his associates in feeding experiments at the Greycliff Station, Montana, and which proved to be the most poisonous of the larkspurs experimented with there *(129, 134)*. However, it was necessary for a cow to eat a considerable amount of the plant to show any ill effects. The toxic dose varied from nearly 23 to 49 pounds. After frost the plant apparently could be eaten with impunity by either cattle or horses and there was no evidence that sheep were affected by eating it. While experiments have not definitely shown that all larkspurs are toxic to this kind of livestock, the wisest range management must assume, preliminary to fuller knowledge, that larkspurs, when abundant, are dangerous on cattle range.

13. In the manuals and other literature, there are numerous references to **giant larkspur** ***(Delphinium robustum*** **Rydb.)** indicating that it occurs in Montana, Wyoming, and New Mexico, but according to Ewan *(65)* this species is confined to Colorado, is "little known," and "not common." The plant has a heavy woody root; stout hollow fine-hairy stems typically 5 to 8 feet tall but in starved specimens sometimes only 18 inches high; finely dissected leaves, and showy, rich blue flowers. Ewan thinks it is a particularly promising species for ornamental cultivation, because of its handsome appearance and the particularly protracted blossoming period. It has been collected on Colorado national forests between 9,200 and 10,300 feet in meadows and grassland and is considered poisonous to cattle. It has been observed chiefly on borders of aspen and coniferous stands.

Marsh, Clawson, and Marsh *(134, p. 50)* report on a feeding test conducted wth giant larkspur on a ranch at Parlins, Colo., where a cow fed with the species was "down" for 1 hour and 7 minutes the first day and for 40 minutes the second day. Because 40 pounds of this larkspur was used per 1,000 pounds of animal, producing symptoms of poisoning late in the season (August 22–23), the authors conclude that it is quite possible that this

species may be one of the most toxic of all the tall western larkspurs. The closely related **Geyer larkspur** or plains larkspur ***(Delphinium geyeri* Greene)** is said by Beath *(15)* in Wyoming to be "responsible for more losses among cattle than * * * all the other poisonous plants of the State combined."

14. **Thickspike larkspur [*Delphinium stachydeum* (A. Gray) Tidestrom,** syn. *D. scopulorum* var. *stachydeum* A. Gray] is, according to Ewan *(65)*, confined to Idaho and Oregon. It occurs in a great variety of soils and sites: aspen-weed, lodgepole pine burns, parks and bottom lands of the ponderosa pine belt, canyons and slopes, edges of lavabeds, black gravelly loams, etc. It has been collected on Oregon national forests between elevations of 5,000 and 6,500 feet, and on Idaho national forests between 5,000 and 8,500 feet.

The plant has a deep woody vertical root; stout stems up to nearly 7 feet tall, rarely only 20 inches high; unusually thick and dense, mulleinlike and spikelike racemes up to 1½ inches broad and 3 to 6 inches long, of blue flowers with long and slender spurs. The fruiting pods *(follicles)* are about ½ inch long, a little spreading at the tips, with numerous, smoky-brown and relatively very large, winged seeds. The flowering period is mainly late June through August. It is poor to fair feed for cattle, fair to good for sheep, and is considered the worst cattle-poisoning larkspur on the Targhee National Forest (Idaho). The specific name *stachydeum* [derived from Greek *στάχυς (spike)*] refers to the thick, spikelike inflorescence.

Isopyrum *(Isopyrum)*

There are three western range species of this genus: **Halls isopyrum *(Isopyrum hallii* A. Gray)**, in the Coast, and Cascade Ranges and the Willamette River valley of western Oregon—the plant named for Elihu Hall (1822–82), well known as a western botanical explorer; **California isopyrum *(I. occidentale* Hook. & Arn.)** of California, and **Siskiyou *isopyrum (I. stipitatum* A. Gray)** in the area from Douglas County, Oregon, to Mendocino County, California.

These isopyrums are small to medium-sized, smooth and rather slender herbs perennial from fleshy and fibrous roots. They have compound foliage somewhat suggestive of that of meadowrue *(Thalictrum)* and mostly white flowers solitary or in clusters *(panicles* or *cymes);* petals are often absent; the 5 or 6 petallike sepals are early-deciduous; the stamens are numerous; the fruit a head of follicles. Species of *Isopyrum*, often called "rue-anemone" a name better restricted to *Anemonella,* are probably negligible as forage plants but more data on this subject are needed. Linnaeus Latinized and transferred to this genus a somewhat uncertain plant name of the Greek physician and herbalist Dioscorides Pedanius, *ισόπυρον*.

Buttercup *(Ranunculus,* syns. *Batrachium, Beckwithia, Coptidium, Cyrtorhynca, Halerpestes)*

Ranunculus,[36] called buttercup in this country, crowfoot in England, bouton d'or (also bassinet, grenouillet, and renoncule) in France, and butterblume in Germany, is an immense genus of practically cosmopolitan distribution—in all continents, in the arctic, tropics, and temperate regions. Nearly 1,800 species have been described and, omitting the homonyms, obvious synonyms and names more deserving of subspecific or lower rank, the number of valid species must still be very large.

About 72 species of *Ranunculus* occur as western range plants and are deserving of discussion here more because of abundance and wide distribution than because of actual forage value. The North American species have been monographed by Benson *(18, 19, 20),* and his treatment is largely followed in the more recent manuals. Buttercups are annual or perennial herbs of greatly varied habitat, but the majority of species are characteristic of moist-wet sites.

The leaves are basal and/or alternate on the stems, sometimes entire but usually lobed or parted. The flowers are, with a few exceptions, yellow, solitary or occasionally clustered; the sepals and petals without spurs, largely 5, rarely 3 or 1, and the petals, which ordinarily have a nectary on their claw, may be as many as 15 or so; the stamens are usually numerous. The fruits (dry, mostly beaked *achenes)* are assembled in dense globular, ellipsoid or short-cylindrical heads on a short receptacle and are very important means of identification in this botanically difficult genus.

At least seven species of this genus are in ornamental cultivation, the most spectacular of which is **Persian buttercup** ***(Ranunculus asiaticus* L.),** from which have been developed plants with very "double" flowers up to 2 inches across and of nearly every shade except the bluish ones.

Although widespread, the buttercups are seldom important forage plants for domestic livestock. Practically all species are low in palatability, and the majority of them complete growth and disappear from the range before midsummer. However, most species are of considerable value as deer and elk forage, these animals commonly using the range early when buttercups are most palatable. All species have a more or less acrid juice.

A few of the more notably acrid species, such as **tall buttercup** or "meadow buttercup" ***(Ranunculus acris* L.),**[37] and especially **blister buttercup,** known also as "rogue buttercup" and "cursed

[36] *Ranunculus,* the Latin word for little frog, was facetiously employed by Cicero to denote the inhabitants of the marshes near Rome and was adopted by the Roman naturalist Pliny for these plants. The common name buttercup comes from the fancied resemblance of the shiny yellow flowers to a cup of butter. The local name crowfoot alludes to the similarity in leaf shape of some species to the foot of a crow.

[37] This name has often been "corrected" to the classical form *R. acer, Ranunculus* being a masculine noun *(52).* However, the original spelling is admissible under later Latin usage.

crowfoot" *(**R. sceleratus** L.)*, are definitely known to be poisonous *(123, 147)*. "Creeping spearwort" [*R. flammula* var. *filiformis* (Michx.) Hook., syn. var. *reptans* (L.) E. Mey.] may also be poisonous, as the species "lesser spearwort" *(**R. flammula** L.)*, which occurs in England, has been shown to be fatal to cattle and horses *(123)*.

Long reports that, in England, the poisonous properties of buttercups vary with the species, the part of the plant, and the season of the year. In the early spring, he states, but little of the poisonous principle is present and some species are not at all poisonous; the flowers are the most poisonous part, then the leaves, and the stem. The toxic principle is volatile and is dissipated in drying, so that buttercups are harmless in hay. The action is chiefly that of an irritant, raising blisters on the skin; when eaten by livestock these species cause inflammation of the mouth and throat and even gastritis, which may prove fatal.

Martin, Zim, and Nelson *(136)* indicate that the achemes of buttercups are eaten by rather numerous birds and rodents, as well as by foxes in eastern Texas, but "the amounts eaten are generally small." The 14 species of buttercup annotated here represent, it is believed, a fair section of the more important western range members of this genus.

1. **Adonis buttercup** *(**Ranunculus adoneus** A. Gray)* ranges from central and southeastern Idaho to Wyoming, Colorado, and Utah. In bloom it is a rather showy little plant. It is a species of the high mountains, collected as low as 6,400 feet on the Challis National Forest (Idaho) and as high as 11,000 feet on the White River National Forest (Colorado), often above timberline or at the edge of snowbanks, chiefly in moist-wet meadows but sometimes in scablands or other rocky areas. It is a smooth plant, 2 to 8 inches high, with fleshy-fibrous roots; fanlike *(flabelliform)* leaves 2's or 3's divided into 3's, the ultimate leaf segments narrowly linear; with rather large flowers, and ovoid, turgid, unwinged fruits *(achenes)*. The flowering period ranges from June to August, depending chiefly on location. The plant is not known to be grazed but more data on palatability are desired. The name *adoneus* refers to a fancied resemblance of the flowers to those of the genus *Adonis*, which, in turn, is named for the handsome mythological youth Adonis.

2. Rather closely related to Adonis buttercup is **Eschscholtz buttercup** *(**Ranunculus eschscholtzii** Schlecht.)*,[38] primarily an arctic or alpine species occurring from Alaska to the Sierra Nevada Mountains of California (where rather rare), thence to Nevada, Utah, Colorado, western Montana, and Alberta. In the variety

[38]The species commemorates Dr. Johann Friedrich Eschscholtz (1793–1831), surgeon, naturalist and explorer, who, with the famous poet-naturalist Adelbert von Chamisso, accompanied Capt. Otto von Kotzebue in the ship Rurik on Count Romanzoff's Russian polar expedition (1815–18). The famous ice cliffs of Eschscholtz Bay on Kotzebue Sound, northwest Alaska, are named for Eschscholtz as is also the well-known California-poppy genus. Actually, the type specimen of Eschscholtz buttercup was collected by Chamisso on the expedition mentioned.

***eximius* (Greene) L. Benson** (syns. *R. eximius* Greene, *R. saxicola* Rydb.) it reaches the San Francisco Peaks of northern Arizona. It is a relatively small and delicate plant, 2 to 12 inches high, with a thickened rootcrown from which a cluster of fibrous roots depend. It is rather variable and includes four named varieties.

The leaves of this species are dissected and somewhat larkspur-like. The basal leaves are somewhat kidney shaped in general outline with rounded or squared *(truncate)* bases, 3 to 5 parted and again cleft, the stem leaves reduced and sometimes 3 lobed. The flowers are yellow, the petals more than half as long as the greenish-yellow sepals; the nectary scale at the base of each petal is attached laterally to the petal forming a kind of pocket. The fruits are oblongish with a straight beak about 1mm. ($\frac{1}{25}$ inch) long.

The plant usually occurs at or above timberline, in wet meadows, wet gravels, and slides, and sometimes is quite abundant. Ordinarily the palatability to domestic livestock is negligible or at most poor. In some places, as on the Flathead National Forest (Montana), it has been noted that deer and elk are very fond of it. The larger flowered forms of the species are ornamental and perhaps worthy of cultivation from that standpoint.

3. **Plantainleaf buttercup *(Ranunculus alismaefolius* Geyer)** (fig. 43) is one of the more common and widely distributed buttercups in the mountains of the Western States. It typically occurs from Vancouver Island and British Columbia to Washington, Idaho, and northern California. The four varieties recognized by Benson *(20)* further extend its range, variety ***hartwegii* (Greene) Jepson** (syn. *R. hartwegii* Greene) reaching Idaho, Montana, and Wyoming, and variety ***montanus* S. Wats.** (syns. *R. calthaeflorus* Greene, *R. unguiculatus* Greene), with 10 petals, occurring in Nevada, Wyoming, and Colorado.

Northern Arizona and southern Utah material identified as *Ranunculus alismaefolius* is probably the related *R. collomae* L. Benson. The purport of the common and specific names is practically similar: *alismaefolius* means like the foliage of the aquatic genus ***Alisma*,** whose species have plantainlike leaves and are known as **waterplantains.**

Plantainleaf buttercup, one of the largest of the entire-leaved buttercups, has stems varying from 6 to 30 inches in height, averaging much taller than the other entire-leaved western species which are usually less han 8 inches high. It is a smooth plant, with a dense cluster of fibrous roots, with thickish, taper-tipped leaves of a lanceolate type up to 6 inches long, mostly entire but sometimes finely toothed; the typically 5 petals are $\frac{1}{4}$ to $\frac{5}{8}$ of an inch long, longer than the sepals; the smooth fruits *(achenes)* are slender beaked about 30 to 50 in a subglobose head a little wider than long.

The bright and shiny yellow flowers appear in May and June. When the plants are numerous and in blossom, their attractive yellow provides a pleasing landscape effect. However, the petals are soon lost, the achenes mature, and the succulent stems and leaves become dry, brown, and brittle. The plants soon start to

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FIGURE 43.—Plantainleaf buttercup (*Ranunculus alismaefolius* Geyer). At right (upper) petal, showing nectary at the base; (lower) individual achene, or fruit.

disintegrate and by late summer the aerial parts have practically vanished from the range.

Plantainleaf buttercup is one of the first plants to appear in the spring, normally growing very rapidly and maturing by midsummer. It inhabits moist to wet sites, and even exists in shallow water, although the soil may become very dry after the plants complete growth. It is most common in meadows, flats, and parks,

and on open streambanks, but it also grows on open slopes. The largest plants and the most dense stands are found in the deep, black loams of flats and meadows; when growing on less fertile and on stony soils, the individual plants are smaller and generally scattered. Mostly it grows in full sunlight, only a few scattered plants occurring in the shade of trees, such as lodgepole pine and aspen, which encircle the open sites where the species grows. It is a plant of the mountains, being practically limited to elevations from the ponderosa pine belt to timberline. In the wetter sites it is likely to occur in pure stand; in the better drained areas it is frequently associated with dandelions, clovers, and bluegrasses.

Although plantainleaf buttercup varies as forage according to locality, it is nowhere highly valued. Use of this species by livestock is limited due to its somewhat acrid taste, which doubtless accounts for its low palatability, and to its extremely early growth, since the plants often mature and practically disappear from the range before the major forage plants are fully developed. It is perhaps most valuable in Wyoming and Colorado, where it is sometimes considered fair for cattle and good for sheep. In Utah, the species is fair for cattle and sheep, but in the Northwest and in California it rates as poor for cattle and fair for sheep. However, deer, and possibly elk also, crop plantainleaf buttercup extensively, probably because this species is one of the earliest herbaceous plants available on the range.

Throughout its natural range, plantainleaf buttercup often increases appreciably where overgrazing and erosion have depleted the original plant cover of good forage species, such as bluegrasses and the better sedges. It is more successfully adapted to invade openings in the plant cover than are most plants, as it makes its growth and matures very early and is usually sparingly grazed because of low palatability. Even though erosion may have been prevented, the replacement of the normal cover by plantainleaf buttercup indicates that some remedial action, such as reduction of the numbers of livestock, is necessary. Successful experiments in improving mountain meadows have been conducted in California in eradication of this species with 2, 4-D preliminary to reseeding *(45, 46)*.

In Washington, Oregon, California, Nevada, and perhaps Idaho is the smaller ***Ranunculus alismaefolius* var. *alismellus* A. Gray** [syn. *R. alismellus* (A. Gray) Greene]. It has finer and fewer roots, broader basal leaves (ovate-lanceolate or even ovate, rather than lanceolate), and fewer and smaller fruits. It occurs in high coniferous forests up to about 11,000 feet and, except for deer and elk, is generally regarded as worthless for forage.

4. **Anderson buttercup [*Ranunculus andersonii* A. Gray,** syn. *Beckwithia andersonii* (A. Gray) Jepson][39] is a handsome little plant which, strange to say, seems not to have come into ornamental cultivation. It ranges from southeastern Oregon to south central Idaho and south to Utah, Nevada, and California. It is a

[39]The species commemorates Charles Lewis Anderson, M. D. (1827–1910), a biographical sketch of whom appears in Madrono 1: 214–216, 1929.

smooth plant, often with great masses of fibrous roots or with a short rootstock from which fibrous roots depend, about 2 to 8 inches high.

The leaves almost wholly basal (occasionally a small stem leaf is present); these leaves are small, kidney shaped *(reniform)* in general outline, with 3 main divisions, each dissected into reverse lance-shaped segments about ⅓ inch long. The usually naked flower stalks *(scapes)* are 1 flowered, the 5 sepals reddish, the 5 petals red, wedge shaped, sometimes almost an inch long, the nectary scale at the base of each petal ridged. The fruits are somewhat flattened and resemble sepals, ⅓ to over ½ inch long. The flowers, which are sometimes more than 2 inches across and showy, appear from late March to June.

Anderson buttercup occurs in foothills and mountains between about 4,500 and 8,000 feet, in gravels, clays, volcanic ash, rocky sagebrush, oak, pinyon-juniper and ponderosa pine types, more often in rather dry sites but sometimes in wet places. It is commonly one of the first plants within its range to appear in the spring, is seldom touched by cattle but sometimes nibbled by sheep; it frequently dries up and disappears by the time stock enter the range.

5. **Bongard buttercup [*Ranunculus bongardii* Greene,** syns. *R. greenei* Howell, *R. lyallii* (A. Gray) Rydb., *R. recurvatus* Bong. (1831) mainly, *not R. recurvatus* Poiret (1804)] occurs from Alaska and neighboring Siberia to California, Colorado, western Montana, and Idaho. It is variable, as its wide range and synonymy attest. Benson *(19)* recognizes two named varieties, of which variety ***tenellus* (Nutt.) Greene** (syns. *R. arcuatus* Heller, *R. douglasii* Howell, *R. tenellus* Nutt.), more slender and often annual, is the more common and important. Typical *R. bongardii* is mainly coastal and the var. *tenellus* mainly interior.

The type of *Ranunculus bongardii* was collected by Bongard[40] at Sitka, Alaska. The typical form is perennial, erect, up to 2 feet high, rough-hairy, the hairs often reddish brown. The basal leaves are larger than those on the stem, heart or kidney shaped *(cordate reniform)* in general outline, 1½ to 3 inches broad, 3 parted, the primary lobes again shallow lobed, the lobes sharp tipped. The yellow flowers, appearing from late April through July, are minute, the sepals reflexed, the 5 petals about 1/18 to less than ½ of an inch long, shorter than the sepals, the nectary scale not forming a pocket. The fruiting achenes are flattened, 1/12 of an inch (2 mm.) long, the beak strongly hooked and longer than the body of the achene.

The plant has been collected on national forests at elevations as low as 200 feet in Alaska and as high as 8,500 feet in western Wyoming. It inhabits mainly shaded and moist sites, and is often associated with sedges, waterleaf, willows, and alders. It is too acrid to be particularly palatable, and its value is generally nil to poor or low; its occurrence is often spotty and it is usually not

[40] August Heinrich Gustav Bongard (1786–1839), a German-Russian botanist who published on the flora of Sitka, Brazil, Russia, and the Bonin Islands.

abundant in any one place. Horses reject it. Reported to be "eaten readily by deer and elk" on the Olympic National Forest (Washington).

6. Closely related to Bongard buttercup is **Macoun buttercup [*Ranunculus macounii* Britton,** syns. *R. hispidus* Hook. (1829) *not* Michx. (1803), *R. rivularis* Rydb., *R. rudis* Greene] which ranges from Newfoundland and Labrador west to Alaska and Siberia and south to California, Arizona, New Mexico, Colorado, Kansas, Nebraska, Iowa, northern Michigan, Ontario, and Quebec. It is a perennial or sometimes apparently annual herb, typically densely beset with rough hairs, the stems 8 to 36 inches high or as long as the plant, especially towards the south; often roots at the nodes, giving a trailing appearance. Sometimes the stems are stout and fistulous and sometimes slender. The so-called variety ***oreganus* (A. Gray) Davis** [syns. *R. hispidus* var. *oreganus* A. Gray, *R. oreganus* (A. Gray) Howell], which is smooth and hairless, is apparently deemed by Benson *(19)* to be not more than a form.

The basal leaves of Macoun buttercup are either 3-divided or pinnately compound into 3 to 5 leaflets, and these in turn parted and the parts lobed, the general outline of the leaf being triangular. The 5 yellow obovate petals are less than ⅓ of an inch (5 to 7 mm.) long, slightly longer than the sepals. The fruits *(achenes)* are ⅛ of an inch (3 mm.) long, smooth, with a short, straight or slightly curved beak, borne in an egg-shaped or somewhat cylindrical head on a hairy receptacle that enlarges considerably in fruit.

The plant occurs in mucky places, along streams, meadows near water, and the like. It has been collected on a gravelly sea beach on the Tongass National Forest (Alaska) and at 9,500 feet under aspen on the Uncompahgre National Forest (Colorado). The flowering period is from late May to early July and the fruiting period mainly July and August. The palatability in general is low. On the Teton National Forest and neighboring Yellowstone National Park (Wyoming) it appears to have moderate value for deer and elk. The plant commemorates John Macoun (1832–1920), well-known Canadian botanist and ornithologist.

7. **Tall buttercup *(Ranunculus acris* L.)**, an Old World species widely naturalized in meadows and fields and along roadsides in the eastern and middle States and Canada, has now invaded parts of British Columbia, Washington, and Oregon. It is entirely too acrid to be at all palatable to grazing animals. Pammel *(151)* reports that its acrid juice is dissipated on drying and that the "symptoms produced in animals are blistering, slavering, choking, vomiting, in some cases followed by death resembling that from apoplexy."

Johnson *(107)* states that in "a herd of cows pastured for years in succession in an old field thickly beset with this weed [tall buttercup], abortion was frequent and troublesome. As soon, however, as this pasture was broken up and the herd moved to another part of the farm in which the plant did not grow, abortion disappeared * * * though there is no positive proof that the abortions

were due to the plant in question, the facts as stated are interesting and significant. It is at least possible that ranunculus exerts an influence upon the reproductive organs like that which is claimed by some for pulsatilla." In this connection, it might be mentioned that Linnaeus named a peculiarly acrid, small-flowered North American buttercup *R. abortivus* L. because of its local reputation as an abortifacient.

8. **California buttercup** [***Ranunculus californicus* Benth.**, syns. *R. dissectus* Hook. & Arn. (1840) *not* Bieb. (1819), *R. latilobus* (A. Gray) Parish] is well-named, because it occurs almost throughout California into Lower California; the varieties ***cuneatus* Greene** and ***gratus* Jepson** extend the range northward into Oregon. It is a hairy or smooth perennial (apparently sometimes annual) from a cluster of rather thickened fibrous roots, 1 to 2 feet high, erect or somewhat bent at the base. The basal leaves are twice or more as long as broad, mostly pinnate with 3- to 5-lobed or parted leaflets.

The bright golden yellow flowers are noteworthy for their numerous (mostly 9 to 16, sometimes as many as 26) petals about ½ inch (8 to 15 mm.) long—much longer than the reflexed, pointed sepals. The receptacle does not elongate conspicuously in fruit; the fruits are strongly flattened, with a short curved beak. The flowering period is late January to May. The species is primarily one of fields, meadows and open hillsides, from about sea level to 6,000 feet or more. In general, it is worthless as forage.

Brewer and Watson *(31)* say: "this is by far the most common and abundant species in the State, and is particularly abundant in the Coast ranges where low grassy hills are often yellow with the shining flowers in early spring." Jepson *(105)* speaks of this plant as "the most common species (of buttercup), everywhere abundant, coloring leagues upon leagues of grassy hills in the late winter and early spring with its profusion of yellow flowers. Running into numerous varieties, which are scarcely distinguishable in any satisfactory way."

In another work *(104)* Jepson adds: "It is a tropophyte, our only species which has accommodated itself to the dry naked hills, but its period of development corresponds to the months of the winter and spring rains when the soil is continuously moist. It is, furthermore, not only our most abundant but our most variable species. In drier regions, i.e., towards the interior, it is less common on the hills and favors low ground; likewise, in Southern California, it is all but confined to cienagas and wet swales." Benson, in Abrams' flora *(2)*, mentions that this species, western buttercup, and **hoary buttercup** (***Ranunculus canus* Benth.**), a large, large-fruited and mostly hoary species of the Sacramento and San Joaquin Valleys and of the Sierra Nevada foothills, have, with their numerous varieties, "an abundance of connecting forms."

9. **Western buttercup** (***Ranunculus occidentalis* Nutt.**) is an exceedingly variable species, very closely related to California buttercup. Benson *(19)* recognizes 10 named varieties; he says of the "*R. occidentalis* complex" *(R. californicus-canus-occidentalis)*, it

"is perhaps only scarcely less difficult to classify than the races of dogs." The typical form of the species is found from Alaska to Oregon.

Ranunculus occidentalis reaches farther south to California in the following four varieties: **Blue Mountains buttercup (var. *dissectus* Henders.,** syns. *R. ciliosus* Howell, *R. marmorarius* Jeps. & Tracy); **Eisen buttercup [var. *eisenii* (Kell.) A. Gray,** syn. *R. eisenii* Kellogg]; **Elk Mountain buttercup [var. *ultramontanus* Greene,** syns. *R. alceus* Greene, *R. ultramontanus* (Greene) Heller] which also gets into western Nevada; and **Rattan buttercup [var. *rattanii* A. Gray,** syn. *R. rattanii* (A. Gray) Howell]. In **Montana buttercup [var. *montanensis* (Rydb.) L. Benson,** syn. *R. montanensis* Rydb.], the species extends eastward into Idaho, western Montana, and western Wyoming; this variety has also been reported from Albuquerque, N. Mex., but Benson *(19)* questions this.

Typical western buttercup is an erect or nearly erect, freely branching perennial herb 8 to 28 inches high, with thickish leaves about ¾ to 2 inches broad, the 3 lobes wedgelike below which, again, are often lobed. The fruits *(achenes)* are smooth and 1/10 of an inch long, with a slender curved beak. The plant is often abundant in meadows, ravines, and woodlands. It has been collected at elevations on national forests from as low as sea level to as high as 6,700 feet. In general, its palatability is regarded as slight.

In contrasting *Ranunculus occidentalis* with *R. canus* and *R. californicus,* Benson *(19)* notes that typically it is the smallest of the 3 species; that the petal number averages fewer (5 or 6) and the petals are usually broader (seldom 2 times or so as long as broad), the leaves are seldom compound, and the achenes are smaller. In contrast with *R. californicus* the petals are fewer (mostly 5 or 6 instead of 9 to 16 or more) and the blades are considerably shorter as compared with the length.

10. **Shore buttercup,** known also as "ivy buttercup," "trailing buttercup," and "water crowfoot," **[*Ranunculus cymbalaria* Pursh,** syn. *Halerpestes cymbalaria* (Pursh) Greene][41] ranges in its typical form from Labrador to Yukon and Alaska and south to Wyoming, Oklahoma, Iowa, Minnesota, Wisconsin, Illinois, and New Jersey. It is a smooth trailing perennial herb, with long trailing stems or stolons which root at the nodes and produce new plants, and naked flower stalks *(scapes)* ¾ to 4½ inches tall. The basal leaves are heart shaped *(cordate),* less than an inch (5 to 22 mm.) long, with shallow scalloped lobes. There are five small yellow petals. The fruits *(achenes)* are in a cylindrical head up to about ½ inch long, the receptacle elongating and becoming cylindrical in fruit. The plant inhabits saline marshes near the coast, the mud of brackish streams, and the like.

The common form in the western range country is ***Ranunculus cymbalaria* var. *saximontanus* Fernald,** often called "desert crow-

[41]The specific name *cymbalaria* refers to the resemblance of the plant to the cultivated Kenilworth-ivy (*Cymbalaria muralis* Gaertn., Mey. & Scherb., syn. *Antirrhinum cymbalaria* L.).

foot," which occurs around waterholes, springs and seeps, edges of lakes, etc., from the sagebrush to the ponderosa pine type, from Vancouver Island and Alberta south to California, central Mexico, New Mexico, Kansas, and South Dakota. The flower stalks are longer than those of the typical form (2 to 12 inches high) and usually branched, the basal leaves are larger (up to nearly 2 inches long), and the fruits more numerous (100 to 300 in a head). This variety has been collected on national forests at elevations as low as 1,400 feet and as high as 9,200 feet.

In addition, there is a northern or alpine variety, ***Ranunculus cymbalaria* var. *alpinus* Hook.**, a small plant from Newfoundland and Quebec to Alaska and Nova Scotia and west to Alaska, which also occurs in Siberia, the Himalayas, and in Wyoming; it has trapezoidal to rectangular leaves 4 to 10 mm. long and is smaller in all its parts, with few stamens and fewer achenes. The forage value of this plant varies, as a rule, from none to low.

11. **Sagebrush buttercup** (***Ranunculus glaberrimus* Hook.**, syn. *R. austinae* Greene) occurs from British Columbia to Plumas County, California, and west to western Montana and western Colorado. In the variety ***ellipticus* Greene** (syn. *R. ellipticus* Greene, *R. waldronii* Lunell) the range is extended farther south to Nevada County, California, the north rim of the Grand Canyon, Arizona, Rio Arriba County, New Mexico, and east to South Dakota and the western edge of the Great Plains.

Typical *Ranunculus glaberrimus* is a smooth perennial herb from a cluster of fleshy-fibrous roots, with more or less reclining stems 1½ to 7 inches long; the basal leaves are rounded ovate, thick, about 1 inch long and shallowly 3 or 5 lobed at the tip, the stem leaves deeply 3 lobed. The petals are usually 5, bright yellow, broadly obovate, about ¼ to ⅝ of an inch (6 to 15 mm.) long. The fruits *(achenes)* are rounded, turgid, 1.5 mm. long, about 75 to 150 in a rounded head, the beaks slender ⅓ to ½ as long as the body; the smooth receptacle enlarges in fruit.

Ranunculus glaberrimus occurs in moist sandy or loamy soils, mostly in sagebrush and grass-weed types, parks and open woodland, between elevations of about 900 and 6,000 feet. The var. *ellipticus* grows at higher elevations, typically in the Rocky Mountains area, up to about 10,000 feet, in the ponderosa pine, Jeffrey pine, spruce, and fir belts. Basal leaves of the variety are up to 2 inches long, entire, elliptical or reverse lance shaped, tapering into the leafstalks; upper stem leaves have an elongated middle lobe.

Benson*(20)* mentions *Ranunculus glaberrimus* as "the first flower of spring throughout most of its range" and Heller *(92)* states that it is "the very first plant to come into bloom in the vicinity of Reno (Nevada) * * * The earliest date upon which is has been found in bloom is January 5th." The larger flowered forms of the plant are quite ornamental. This species ordinarily has low palatability but is often taken in early spring because of lack of better vegetation. The higher range var. *ellipticus* often disappears by the time livestock are admitted to the range; it is often small but locally abundant.

12. Rather close botanically to sagebrush buttercup is **smallflower buttercup [*Ranunculus inamoenus* Greene,** syn. *R. micropetalus* (Greene) Rydb.], the typical form of which ranges from Alberta south to Custer County, Idaho, western Montana, Wyoming, Colorado, the San Francisco Peaks of northern Arizona and the Sacramento Mountains of New Mexico. It is a more or less hairy plant, about 4 to 12 inches high, the basal leaves simple, ovate to orbicular, mostly entire, ½ to 1½ inches long, the stem leaves with 3 to 5 linear lobes.

The scientific name *inamoenus* refers to the "unpleasing" appearance of the very small flowers, the petals being rather narrow, little or not much longer than the sepals and 2.5 to 8 mm. (less than ⅓ of an inch) long. The obovate fruits *(achenes),* with slender curved beaks, are crowded on a rough-hairy receptacle that becomes twice longer (¼ to ½ of an inch) in fruit, about 60 to 100 in number, and form a more or less cylindrical head.

Smallflower buttercup occurs in moist, sandy, gravelly or clayey loams, in grass, weed, sagebrush, woodland or open conifer types up to about 10,500 feet. The flowering period is from April to July. Such forage value as the plant possesses is in early spring; the palatability mostly is low. Castetter *(36)* reports that the Acoma and Laguna Indians of New Mexico regard the roots of this buttercup as "quite edible" but that they sometimes mistake the roots for those of the so-called "desert crowfoot" ***(Ranunculus sceleratus* var. *multifidus* Nutt.,** syn. *R. eremogenes* Greene) which they consider poisonous.

A common variety of *Ranunculus inamoenus* is variety ***alpeophilus* (A. Nels. L. Benson** (syns. *R. alpeophilus* A. Nels., *R. utahensis* Rydb.), sometimes called "Nelson buttercup" and "Utah buttercup." This differs from the typical form in being practically hairless *(glabrous)* throughout, with 3-parted or deeply 3-lobed basal leaves and a hairless receptacle. It occurs from British Columbia and Pend Oreille County, northeast Washington, to Nevada, Utah, Colorado, and Wyoming, mostly in the lodgepole and upper ponderosa pine type, between elevations of 8,300 and 10,000 feet.

13. **McCauley buttercup *(Ranunculus macauleyi* A. Gray),** although of very limited range (south central and southwestern Colorado and northern New Mexico) is worthy of mention because of its handsome appearance and being one of the very few native buttercups in ornamental cultivation. It is a high-range plant, growing in wet places among rocks, alpine meadows, snowbank edges, etc. The species has been collected in Colorado at elevations from 9,500 to 12,000 feet, in flower at various dates from June 4 to August 21; in Colorado in red clay loam, associated with fescue, phlox, sieversia, and sagebrush; and in New Mexico at 13,000 feet, well above timberline.

McCauley buttercup is a low plant, about 4 to 6 inches high, from a cluster of fleshy-fibrous roots, soft-hairy when young but soon smooth, the thickish leaves, mostly of an oblong-elliptic type, 2- to 4- (sometimes 5- to 10-) toothed at the apex. The flowers are

large and showy, a deep or bright yellow, the 5 or 6 petals broadly obovate and about 2/5 of an inch long, the sepals rich brown and conspicuously black-hairy, making a striking contrast with the petals. The fruiting heads are egg shaped to rounded, the fruits *(achenes)* with very short, straight beaks. Probably of no great importance as forage. The plant bears the name of Lt. Charles Adams Hoke McCauley, U.S.A., a native of Maryland, who collected the type material of the species in San Juan County, Colo., in 1877.

14. **Straightbeak buttercup** ***(Ranunculus orthorhyncus* Hook.)** occurs from Vancouver Island to California, apparently also in the Yellowstone Park region (northwestern Wyoming). In the variety ***alaschensis* L. Benson** is occurs on the south coast of Alaska and, in **great straightbeak buttercup,** or "giant buttercup" **[var. *platyphyllus* A. Gray,** syns. *R. maximus* Greene, *R. platyphyllus* (A. Gray) A. Nels., *R. politus* Greene], the range extends east to Idaho, western Montana, Wyoming, and Utah.

In its typical form, this is a rather stout-stemmed plant 6 to 20 inches high, from clustered, thick-fibrous roots, the herbage usually rough-hairy with ascending hairs. The basal leaves are compound, have a slashed appearance and are up to about 6 inches long, pinnately parted into 3 to 7 leaflets and these again twice forked into narrow divisions. The flowers are sometimes large and showy, the sepals reflexed, the 5 petals (often red on the back) up to 3/4 of an inch or more (8 to 19 mm.) long. The fruits, about 12 to 20 in a head, have a conspicuous straight beak about 1/6 of an inch (4 mm.) long; the rough-hairy receptacle enlarges only slightly in fruit. The flowering period is mainly May to July.

Ranunculus orthorhyncus var. *platyphyllus* (syn. *R. maximus*) differs from the typical form chiefly in being larger (about 2 to 4 feet high), the stems being stouter and the hairs more spreading; the petals broader and shorter; the achenes more numerous (20 to 35) their beaks somewhat shorter and softer, and the receptacle more elongated (5 to 9 mm. instead of 2 to 3) in fruit. This variety is perhaps the largest of our native buttercups.

The species, in both typical and *platyphyllus* varieties, occurs in swamps, wet meadows, and other moist-wet sites near the coast, in the foothills and in the mountains, from elevations as low as 300 feet to as high as 9,500. As a forage plant it is frequently disregarded by livestock or else nibbled slightly.

Watercrowfoot buttercup or "water crowfoot" ***(Ranunculus aquatilis* L.)**, an aquatic Eurasian buttercup, is represented in the United States by four varieties, of which the following is much the most widespread and important: **hairleaf watercrowfoot buttercup [*R. aquatilis* var. *capillaceus* (Thuill.) DC.,** syns. *R. aquatilis* var. *trichophyllus* (Chaix) A. Gray, *R. capillaceus* Thuill., *R. trichophyllus* Chaix, *Batrachium trichophyllum* Chaix, F. Schultz]. This variety occurs from Newfoundland and Labrador to Alaska and south to Lower California, Arizona, New Mexico, South Dakota, Minnesota, Pennyslvania, and New England. It also occurs in Europe and Asia. The leaves are submersed and finely dissected

into hairlike segments; the flowers are white. The plant inhabits ponds, irrigation ditches, streams, wet meadows, and the like.

On western range the forage value of *Ranunculus aquatilis* is generally considered negligible or low. Long *(123)* indicates that, in Great Britain, "fresh *R. aquatilis* is held to be quite harmless, and has been used as a fodder." He quotes another author as follows: "Along the banks of the Hampshire Avon, and other places in the same neighbourhood, it is used by the peasantry * * * They collect it in boats and give it to their cows and horses, allowing the former about twenty to thirty pounds a day. One man is said to have kept five cows and a horse with little other food but what they could pick up on the heath, using no hay but when the river was frozen. Hogs eat it and will live upon it alone until put up to fatten."

Bulbous buttercup (*Ranunculus bulbosus* L.), widely naturalized from Europe and a common pest in lawns, is a rather handsome plant in flower, and Fernald and Kinsey *(70)* report that in the spring, if thoroughly dried, the bulbous roots are sweet and edible. They also report that ***blister buttercup*** **(R. sceleratus L.)**—at least partially naturalized from Europe, another weed in cultivated ground *(142)*—is used as a potherb in Europe after thorough changing of water to remove the irritating and toxic ingredient *anemonol.* Pammel *(151)* states that it is used in Europe by beggers for making sores.

White globeflower [*Trollius albiflorus* (A. Gray) Rydb., syn. *T. laxus* var. *albiflorus* A. Gray] is a handsome, smooth herb, 6 to 24 inches high, perennial from a thick cluster of fibrous roots; the palmately divided basal and stem leaves are somewhat suggestive of those of a larkspur; the white flowers are large, solitary, and white, with about 5 to 8 petallike sepals, the petals about as many, inconspicuous and with nectaries at the base; the stamens are numerous and the pistils about 5. The fruit is a cluster or head of small pods *(follicles)*.

The plant is found mostly in black mucky soils, marshes, wet meadows, streambanks and the like at higher elevations from British Columbia and Alberta to western Montana, Colorado, northern Utah, and Washington. It appears to be absent from Oregon. It has been collected at elevations as low as 4,000 feet in Washington and as high as 11,500 feet in Colorado. The flowering period is mostly June and July and the fruiting period August and September. In most places the forage value is negligible or of distinctly minor importance though sheep may sometimes be seen to pick off the leaves and flowers. However, deer and elk may take it rather freely in early summer, and it is reported to be grazed by mountain sheep and mountain goats.

Some authors prefer to merge *Trollius albiflorus* with the typically eastern **American globeflower (*T. laxus* Salisb.)**, and it was originally described as a variety of that species; however, the widely separated range, the different flower color *(T. laxus* has greenish-yellow flowers), and broader sepals of the western plant make it seem preferable to keep the latter distinct. These 2 are

the only American species of the genus; they, together with about 8 Asiatic and European species, are in ornamental cultivation, the flower colors varying from white to yellow and purple.

Peony Tribe (Paeonieae)

Peony *(Paeonia)*

Perennial herbs or small shrubs, all native to Europe and Asia except for two species in Western United States. They have thick roots; ternately or pinnately compound or dissected leaves; large and showy, purple, red, white or yellow flowers, with 5 to 10 (much increased in cultivated double flowers), often thick and roundish sepals and petals, numerous stamens on a disk, and 2 to 5 pistils ripening in fruit into thick, leathery, oblonglish "pods," or follicles with large, rather fleshy seeds.

Practically all species of *Paeonia* are in ornamental cultivation, but the common herbaceous peony of the gardens consists of many forms of the **common peony [*P. lactiflora* Pall.,** syns. *P. albiflora* Pall., *P. edulis* Salisb., *P. fragrans* Redoute], of Siberia and China whose starchy tuberous roots are used as food in its native countries. Unfortunately this species has been much confused in the books with **drug peony (*P. officinalis* L.)**, a little-cultivated species of southern Europe and western Asia, with white-woolly fruits and nontapered leaf segments, and which formerly was an official drug plant. The Chinese so-called **tree peony (*P. suffruticosa* Haw.,** syns. *P. arborea* Donn, *P. moutan* Sims) is also in common cultivation in this country.

The genus has been monographed by Stern *(190)*. There is an American Peony Society, which issues books and other literature on cultivated peony varieties. Paian, or Paion (Anglicized to Paean or Paeon) was the mythological physician of the gods on Mt. Olympus and with his name, apparently, were connected more or less closely, Paeonia, a province of ancient Macedonia, Paeonian (an epithet of Apollo, god of medicine), and paean, a thanksgiving hymn addressed to Apollo or Artemis. Tournefort (1656–1708), "the father of plant genera," gives the meaning of *Paeonia* (and peony) as follows: "Paeonia a Paeone Medico, qui ea curasse perhibetur Plutonem ab Hercule vulneratum, ut refert Homerus Odyss."—that is, from the mythological Paeon who, according to Homer's Odyssey, cured Pluto with this plant when he was wounded by Hercules.

Browns peony *(Paeonia brownii* Dougl.) (fig. 44) was originally collected by David Douglas ("Douglas of the Fir") near perpetual snow on Mt. Hood, Oregon, in 1826, and named by him after Robert Brown (1778–1858), eminent British botanist. It is often locally known as "skookumroot" and "watermelon plant."

The species ranges from Vancouver Island south to California and east to Utah, Wyoming, Idaho, and Alberta. Harrington *(90)* suspects its occurrence in northwestern Colorado but apparently it has never been collected nor observed in that State. In Oregon and Washington Browns peony occurs principally on the east side

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FIGURE 44.—Browns peony (*Paenoia brownii* Dougl.).

of the Cascade Mountains; it extends southward in California as far as Santa Clara and Tuolomne Counties *(188)* but is rare in the Coastal Range. Although rather common in the Pacific States and in parts of Idaho and Nevada, the species is extremely rare in Utah.

Browns peony is a more or less bluish- *(glaucous)* green and succulent perennial herb, with numerous leafy stems 8 to 20 inches high coming from an elongated thick woody taproot often with fleshy and starchy, almost tuberous branches, long-stalked and

ternately compound leaves and solitary, terminal, drooping flowers with 5 or 6 thick and leathery, dull brownish-red petals, which soon fall off. The petals extend but slightly beyond the (5 or 6) sepals, which are usually of the same hue as the foliage. The flowers are often fragrant, but the leaves and stems have a peculiar odor. When young, the stems are erect but droop as they mature until the fruits finally rest upon the ground. Ants and possibly other insects manifest a peculiar liking for the tissues of this plant and sometimes destroy the flowers and honeycomb the leaves.

Browns peony grows through a rather wide range of habitat conditions varying from fairly dry mixed bunchgrass, weed, and sagebrush types to cool, moist slopes near perpetual snow. It ranges from about 1,000 feet above sea level to elevations of more than 8,000 feet; in Idaho mostly between 4,000 and 6,500, in Nevada between 6,500 and 8,000 feet, and in California between 3,000 and 6,000 feet. It usually occupies well-drained sites, chiefly sandy or gravelly loams both of granitic and limestone origin, but may inhabit brushy hillsides, rich black soil, or grow in open stands of aspen or coniferous timber. The plant generally occurs in scattered clumps and seldom, if ever, in pure stands. Ordinarily comprises but a small part of the plant cover.

This species starts growth early in the season, customarily being among the first of the flowering plants to appear in the spring; the flowering period is chiefly late April through June. The succulent leafage usually matures early, and, except in the moister and more shaded sites, becomes dry, brittle, and worthless for forage before the close of the grazing season. Consequently, this plant is of most value for forage on ranges grazed in spring and early summer.

In general, as Sampson *(176)* indicates, the succulent herbage of Browns peony is eaten with relish by sheep but only lightly by cattle. However, the palatability varies somewhat; on some ranges it is rated as only fair for sheep and worthless for cattle, and some observers even report that it is never grazed at all in their localities. This species appears unable to withstand close cropping for many consecutive seasons. In preliminary range reseeding trials on the Wasatch Plateau in central Utah *(75)*, Browns peony became established from the original seeding but failed to reproduce.

The late Dr. Stockberger of the Bureau of Plant Industry (now Agricultural Research Service) wrote the Forest Service about Browns peony as follows:

> "* * * there is a decided lack of experimental data on the (supposititious) toxicity of this plant. In northern California the leaves are locally reputed poisonous to touch, but the root has been considered a good remedy for dyspepsia when eaten raw. Some years ago the herbaceous parts of this plant were collected on an area reputed 'poisonous, where it was abundant.' An alcoholic extract was prepared from this material and 25 grams of it administered to a rabbit weighing 4 lbs., 3 oz. without toxic effect. Although the data at hand are insufficient to permit the drawing of definite conclusions, the balance of available evidence does not lend much support to the assumption that *Paeonia brownii* is harmful."

In addition to the local medicinal use of the plant mentioned by Dr. Stockberger, there is frequent mention in literature of the use

of the thick roots of Browns peony by Indians in doctoring colds, sore throat, and to give their horses long wind. Old settlers along the Salmon River in Idaho (and possibly elsewhere) prize this plant as an alleged cure for rheumatism.

Due apparently to the prestige of Torrey and Gray, a second native peony, **California peony** [***Paeonia californica* Nutt.**, syn.*P. brownii* ssp. *californica* (Nutt.) Abrams], has been ignored in the manuals. This has contributed to confusion about the range and other characters of Browns peony. Stebbins *(188)* has presented cogent arguments that Greene *(84)* was correct in restoring this species in 1890. California peony has a quite different range, from sea level to about 4,000 feet in south central and southern California from Monterey to San Diego Counties, the type locality being near Santa Barbara.

Unlike Browns peony, California peony is not hardy, is a taller (up to 30 inches), more stemmy (up to 30), more branching and leafier plant, with thin and soon wilting, green rather than bluish foliage, elliptic rather than rounded petals, and flowers of a deep blackish-red hue. The leaf divisions are quite different, the primary divisions or segments with an elongated, gradually tapered and narrow wedgelike base and narrower and usually more elongated ultimate segments with usually sharp-pointed rather than blunt lobes. Reference to the illustrations, table, and key in Stebbins' paper *(188)* will make these points clearer.

California peony grows in and along stream bottoms and in chamise and woodland-grass types, blooming in January and February and fruiting in March and April. It is sometimes known locally by the misnomer "Christmas-rose." More information as to its palatability to domestic livestock and wildlife is needed.

BARBERRY FAMILY (BERBERIDACEAE)

This is a family of shrubs or herbs with alternate or basal leaves, flowers with sepals and petals (which are occasionally absent) arranged shinglewise *(imbricated)* in bud and usually in 2 rows of 3 each; stamens inserted under the ovary and usually equaling the petals and opposite them; the fruit a berry or capsule. The group is closely related botanically to the buttercup family *(Ranunculaceae);* barberry family anthers (except in the somewhat anomalous genus *Podophyllum*) open by two flaplike uplifted valves, and there is only one pistil (instead of many). The woody **barberry** ***(Berberis)*** and ***mahonia*** or "hollygrape" ***(Mahonia,*** syn. *Odostemon)* genera are annotated in Important Western Browse Plants *(54)* and the Range Plant Handbook *(204)*. In addition, there are two western herbaceous genera of the family.

Vanillaleaf [***Achlys triphylla* (Smith) DC.**], known also as "deerfoot," "sweet-after-death," and "threeleaf," was long thought to be the only species of the genus until a second one was later discovered in Japan. It is a herb, with an agreeable vanillalike fragrance, perennial from creeping scaly rootstocks, and ranges, commonly in damp sites under the shade of Douglas-fir, western hemlock, spruce

and other conifers, from British Columbia south to Mendocino County, California.

Vanillaleaf has a solitary, long-stalked, 3-leafletted leaf, the 2 broad lateral leaflets somewhat suggesting a butterfly's wings, and a naked flower stalk, up to about 16 inches high, with a terminal spike of white, fragrant sepalless and petalless flowers, with 6 to 13 stamens, and succeeded by the small, somewhat kidney-shaped and reddish or purplish fruits. It ranges from a little above sea level to about 4,000 to 5,000 feet in Oregon and Washingon. In general the forage value of this plant is low to negligible; it is, however, of moderate value as deer and elk feed in spring and, in places, assumes a little importance.

Vancouveria *(Vancouveria)*

A genus of three species, commemorating the British navigator Capt. George Vancouver (1758–98), sometimes called "inside-out-flower," is confined to the coastal region of the Pacific Northwest. They are perennial, essentially stemless (save for the leaf and flower stalks) herbs from slender, more or less woody rootstocks, with leaves twice or thrice compounded in 3's and somewhat suggesting those of some maidenhair-fern; nodding flowers with narrow, bent backwards *(reflexed)* sepals and petals in 6's, the petals with hoodlike nectaries at the tip; 6 protruded stamens with beaked anthers, and a small 2-valved fruit.

The commonest species is probably **white vancouveria [*V. hexandra* (Hook.) Morr. & Dec.]**, ranging from near the mouth of the Nisqually River, western Washington, south to Mendocino County, California; it has been reported also (but perhaps somewhat questionably) from southern Vancouver Island and southwestern British Columbia, chiefly in dense Douglas-fir and western hemlock forests. The leaves are basal, with relatively thin and deciduous, somewhat shield-shaped leaflets. The flowering and fruiting stems are up to about 16 inches high, smooth and with relatively few, white flowers up to about ½ inch long.

Where abundant the species assumes some forage significance. On the Rogue River (formerly Crater) National Forest (Oregon) estimates of its fall palatability to cattle have run as high as 50 percent. The related yellow-flowered, glandular-hairy **yellow vancouveria *(V. chrysantha* Greene)** hos been reported to have "no apparent forage value."

POPPY FAMILY (PAPAVERACEAE)

There are 12 genera and about 41 species of this family in the Far West. However, Dr. Edward L. Greene, formerly consulting expert of the U. S. Forest Service in matters of plant nomenclature, separated **creamcups (*Platystemon californicus* Benth.)** into 52 species, and the **goldpoppy** genus ***(Eschscholzia)*** has lent itself to similar treatment at the hands of various specialists. California is easily the center of distribution.

Members of this family often have milky, colored, acrid, or

narcotic juices. **Bushpoppy** ***(Dendromencon)***, a California genus of two species, is shrubby, and the monotypic, southern California —Lower California **Matilija-poppy** (***Romneya coulteri*** **Harvey**) is half shrubby, with a woody base. The rest of our species are herbs with mostly alternate, simple or compound leaves. In ***Meconella***, however, a Pacific genus of low annuals, the leaves are opposite, and they are often opposite in ***Platystemon*** or, as in the annual genus ***Canbya***, largely in basal tufts.

The flowers, often showy, usually have 2 sepals that fall off when the petals expand as do likewise, a few days later, the mostly 4 to 12 often wrinkled petals. In ***Canbya*** and ***Platystemon***, however, the sepals are 3; they are usually 3 in ***Meconella*** and often 3 in **bearpoppy** ***(Arctomecon)*** and **pricklepoppy** ***(Argemone)***. In ***Arctomecon***, the withered petals persist around the capsule base, and in ***Platystemon*** the petals are only tardily deciduous. In the Oriental **plumepoppy** ***(Macleaya)***, much cultivated as an ornamental, the petals are absent. The stamens are distinct, usually numerous but may be as few as 5 or 6, the pistil usually single. Ordinarily the fruit is a capsule opening by valves or pores or, if the pistils are two or more, a group of larkspurlike follicles are developed, opening to discharge the copious small seeds.

As a class, the poppy family is largely characteristic of dry warm sites. However, there are at least seven species of true poppies *(Papaver)* in Alaska, and some members of the family have become acclimated to boreal conditions and are found as far north as any flowering plant can grow. In parts of the West, notably California and the Southwest, Papaveraceae are sometimes extremely abundant and give, for a time at least, a chief character to the local landscape. Many of them, with their gay-colored, frilled flowers, are prized as ornamentals. The group is active chemically and the narcotic properties of the type genus *Papaver* have been known and utilized by man since prehistoric times. Especially is this true of the type species, **opium poppy** (***P. somniferum*** **L.**), from which opium and its constituents are derived. Morphine, in fact, is reputed to have been the first alkaloid isolated and named by chemists.

As forage plants Papaveraceae are relatively unimportant. With the possible exception of *Eschscholzia* they are disliked by livestock which will, however, consume them if there is a shortage of better feed. While the family has a record of poisoning stock in Europe, the writer is unaware of any similar record for western range species. However, it is possible that members of this group may have been involved in obscure cases of sickness or loss. Where abundant on the range, it is the safest policy to regard them with some degree of suspicion. They are probably more dangerous in fruit than at any other time, since, the narcotic properties apparently are resident mostly in the capsules.

Pricklepoppy *(Argemone)*

Argemone[42] is a genus of about 10 species, of which about 6 are in the western range area. They are annual, biennial or perennial, bluish, very prickly herbs, or one Mexican and one or two South American species shrubby; the acrid juice is yellow, orange colored, or whitish. The alternate leaves, clasping at the base, are divided like an oak leaf *(pinnatifid)* or have wavy edges *(sinuate)*, the divisions ending in a stout prickle. The showy flowers, erect in bud, are mostly white but are sometimes yellowish or rose colored; the 2 or 3 sepals have a hornlike appendage below the tip, the petals 4 or 6, stamens numerous and forming a conspicuous yellow center, the stigma stalkless *(sessile)*. The fruit is an oblong capsule opening from the top by 4 to 6 valves, and contains numerous rounded seeds with a latticelike surface.[43]

Their extreme prickliness and questionable palatability render these plants unattractive, as a rule, to range livestock, and their abundance locally may be an indication of overgrazing. It is possible that all species possess narcotic properties, and, when abundant on badly overgrazed areas, may be potential sources of sickness. They are often called "thistle poppy" and, by Mexican people, "chicalote." At least three species have become locally naturalized in the Eastern States and several are in ornamental cultivation as "annuals" because of their handsome flowers.

Intermediate pricklepoppy (*Argemone intermedia* Sweet) is closely related to the more common *A. platyceras* but the capsules are sparsely instead of densely prickly, the stems without hairs or only sparsely hairy, the slender sepal horns elongated and swollen at the base only. It occurs on deserts, mesas, foothills, and in the woodland type from South Dakota to Colorado, Texas, New Mexico, and Arizona, and south into northern Mexico. It has become introduced and locally naturalized in Illinois and elsewhere. It blooms almost continuously from the seedling stage and is seldom observed to be grazed.

Mexican pricklepoppy (*Argemone mexicana* L.), the botanical type of the genus, has pale yellow to orange-colored flowers and sparsely spiny foliage with light blotches. It was originally known from Mexico but has been extensively cultivated and is now escaped and locally naturalized almost throughout the United States, especially in the South. It is also widely distributed throughout the tropics, in Australia, Africa, and many other (especially warmer) parts of the world.

Pammel *(151)* reports that the prickly pods and leaves of both *Argemone mexicana* and *A. intermedia* cause severe mechanical

[42]The name *Argemone* appears to have originated with the illustrious French botanist Joseph Pitton Tournefort (1656–1708), "the father of genera who evidently put in roman letters a name used by a Greek medical writer, apparently of the first century A.D., for a kind of sore or ulcer of the cornea of the eye for which argemone was deemed a remedy.

[43]Botanically, *Argemone* is close to the poppies (*Papaver* spp.). It differs chiefly in that it has mostly white flowers that are not nodding in bud and very different fruits. It also differs in its prickliness.

injury and inflammation. Schneider *(180)* states that *A. mexicana* "has marked emetic, purgative, and narcotic properties." Kearney and Peebles *(109)* mention the local use of the "acrid yellow juice of *A. mexicana* * * * to treat cutaneous diseases."

Crested pricklepoppy (*Argemone platyceras* Link & Otto) (fig. 45) is, with its variety *hispida*, probably the commonest member of the genus. It ranges from western Nebraska and southern Wyoming to Colorado, California, Arizona, New Mexico, and western Texas, and south to Mexico (the type locality). Owing to cultivation as an ornamental, it has become locally naturalized in Oregon and probably elsewhere.

Crested pricklepoppy is a coarse, stout, spiny-prickly biennial or short-lived perennial herb, the stem prickly-bristly with straw-colored prickles, the herbage bluish *(glaucous)*. The alternate, pinnatifid or lobed and clasping leaves are without blotches. The large, showy flowers are about 4 inches broad, with 2 (rarely 3) deciduous, horned sepals, the horns dilated and spiny, the petals 4, early deciduous, thin, and delicate. The four valves of the fruiting capsules are densely armed with prickles.

This species is found from near sea level to about 7,500 feet, often in dry sandy soils on plains, hillsides, canyons, draws, and in woodland and ponderosa pine parks. Frequently it is a dominant weed especially on severely overgrazed ranges. The main flowering period is May to September, but it may be found in bloom at any time when climatic conditions permit. Ordinarily the palatability is nil, but the plant may occasionally be observed to be nibbled by cattle when it is young and tender.

So far as the writer is aware, no feeding experiments with this species have ever been conducted, but there is every likelihood that it is more or less poisonous. The seed, however, seems to be harmless and is a favorite local item for seed-eating birds, such as doves. The prickles are highly irritating to the skin of many people.

Hedgehog pricklepoppy [*Argemone platyceras* var. *hispida* (A. Gray) Prain, syn. *A. hispida* A. Gray] differs from typical *A. platyceras* chiefly in having the stems rough-hairy *(hispid)* in addition to being densely prickly. The root is woody and sometimes branched at the crown and a yellow latex oozes from freshly cut stems. It has a relatively similar range and distribution but tends, on the whole, to grow at somewhat higher altitudes and more northern areas. It is not known to be eaten by range livestock.

Goldpoppy *(Eschscholzia)*

Eschscholzia,[44] an attractive genus native to western North America, has been subjected to considerable "splitting," but there are possibly as many as 11 or 12 species, conservatively speaking,

[44]The original spelling *Eschscholzia,* as against the more familiar *Eschscholtzia,* is here retained in conformity with the International Code of Botanical Nomenclature. The name was established by the German naturalist and poet Adelbert von Chamisso (1781–1838) in honor of his friend and companion Dr. Johann Friedrich Eschscholtz (1793–1831), German physician, naturalist, and poet, both of whom visited California in 1816.

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FIGURE 45.—Crested pricklepoppy (*Argemone platyceras* Link & Otto).

in the western range country. These plants are mostly smooth *(glabrous)*, often bluish *(glaucous)* annuals or short-lived perennials, with colorless, bitter sap, *(ternately)* dissected leaves, and attractive orange or yellow flowers borne on a funnel-shaped, dilated receptacle *(torus)* around the base of the ovary.

The two sepals, adhering together in a pointed, hoodlike cap *(calyptra)*, fall off as the petals expand. The petals, usually 4 but sometimes as many as 8, surround the numerous stamens that have short stalks *(filaments)* and linear anthers; the stigma is 4 to 6, linear lobed. The fruiting capsules are elongated, 10 nerved, separating from the base and contain the rounded, netted or minutely warty seeds which, when ripe, are expelled with considerable force.

These plants are especially characteristic of dry, often desertlike sites where, in bloom, they may be the chief local feature of the landscape. They appear to have no great forage importance and, pending further study, perhaps should be regarded with a little suspicion in view of the toxic alkaloids some are known to possess. Except possibly for **little goldpoppy (*Eschscholzia minutiflora* S. Wats.)** of the Great Basin and Southwest, which has very small flowers, probably most or all of the species are in ornamental cultivation.

California-poppy (*Eschscholzia californica* Cham.),[45] the *copa de oro* (cup of gold) of Spanish-Americans, is a variable plant, almost a hundred segregated "species" of it having been proposed by some botanists. It may be an annual or a short-lived perennial from a sometimes thick and branching rootstock, the stems more or less ascending or trailing.

The leaves (bluish in the typical coastal form) are thrice compounded *(ternately decompound)*, the segments linear to oblong, smooth and hairless, or sometimes slightly and minutely hairy. The mostly 4, fan-shaped petals may be as much as 2½ inches long or considerably smaller, bright yellow in the typical form and varying to orange, the flowers borne on the characteristic *torus* (an enlarged, funnel-shaped receptacle surrounding the ovary) which, in this species, has *two* rims, the inner one erect, the outer and lower one spreading. The seeds are netted-veined.

The typical form is found on sandy bluffs and dunes along the California coast. It is found in grass, chamise, sagebrush, and other types, often in grainfields, railroad rights-of-way, dry washes, etc., growing in full sunlight. Because of extensive cultivation as an ornamental, California-poppy is now locally naturalized in practically every Western State, as well as in Europe, Australia, and elsewhere.

Ordinarily, as a forage plant, California-poppy is rated poor for cattle and fair for sheep. As silage, however, the palatability appears to be enhanced. Westover *(208)*, in one study of this plant

[45]California-poppy is the official State flower of California. The author of both the genus and the species is the romantic figure Adelbert Louis Charles Adelaide von Chamisso (1781–1838). Driven from France by the Revolution, he became an early German explorer of the California coast, botanist, poet, song writer, and author of the celebrated *Peter Schlemihl*, the story of the man who sold his shadow.

harvested when in full bloom, found the cured silage wet and slimy but with a pleasant odor; he states that it was taken readily by cattle. The plant, after boiling or roasting and then rinsing, was a food plant among California Indians. Smith *(181)* and Schneider *(180)* mention its being prized by Spanish-Americans as a hair tonic; the flowers (dried in the sun) or the boiled leaves were treated with olive oil, the mixture strained, and perfume added. The U.S. Dispensatory *(147)* states that the plant contains an alkaloid, which apparently has a sedative effect, and that it has been used locally to relieve headache, toothache, and insomnia.

Eschscholzia californica var. *crocea* (Benth.) Jepson occurs from the Columbia River valley, southern Washington, to northern Baja California, at higher elevations than the typical form, in foothills and valleys almost up to the ponderosa pine belt. Jepson *(104)* mentions that it has two seasonal phases. In spring, the flowers are large and deep orange, the stems numerous and erect, and the torus, or swollen receptacle at the base of the flowers, very pronounced. In summer, the stems are fewer and more spreading, the buds much shorter and short pointed, the flowers smaller, pale or straw colored, and the torus, or receptacle, reduced. The juice of the roots is sometimes reddish.

Mexican goldpoppy [*Eschscholzia mexicana* Greene, syn. *E. parvula* (A. Gray) Cockerell] (fig. 46) grows on dry plains and foothills, mostly in the sagebrush and creosotebush belts, from western Texas to southern Utah, southern Nevada, Arizona, and Sonora, up to about 4,500 feet. It is a (largely winter) annual, with bluish *(glaucous)* herbage, the dissected leaves largely basal. The showy orange-colored (more rarely light yellow, white or pinkish) flowers appear from February to May; the stamens are 20 or more, the fruiting capsules elongated, 10 nerved, opening their full length from base to apex to discharge the numerous dark seeds that have a wrinkled and netted surface.

The abundance of the plant fluctuates greatly from year to year due to seasonal variations in rainfall. Ordinarily the palatability is low, but there is a great difference of published opinion on this matter. Thornber *(201)* speaks of its abundance on spring range in Arizona between 2,500 and 4,500 feet and states that it is "considerably grazed." Griffiths *(86)*, while admitting that it is grazed during winter and spring on various Southwestern grazing grounds, intimates that personal observation "does not entirely confirm these views" of good palatability. Reported observations of palatability as high as 95 percent for cattle and horses undoubtedly are correlated with absence or scarcity of more nutritious and palatable vegetation.

Poppy *(Papaver)*

The poppy genus is largely confined to the Old World and has lent itself greatly to what is called botanical "splitting." The nomenclature of our native species is still somewhat in dispute. Several Old World species are locally naturalized from gardens.

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FIGURE 46.—Mexican goldpoppy (*Eschscholzia mexicana* Greene).

About two arctic species crop out again on high summits of the Rocky Mountains.

Poppies are annual or perennial herbs, with more or less narcotic, milky sap; lobed or dissected leaves; solitary, long-stalked, showy flowers, nodding in bud and of various colors, mostly red, orange, yellow, purple, violet, or white, and typically with 2 sepals and 4 petals and numerous stamens. The stigmas are united into a flattened, crownlike, 4- to 20-rayed structure persistent as a cap

on the fruit. The characteristic fruiting capsules open by chinks or pores under the stigmas.

Papaver is the Latin word for poppy. The genus is chiefly known for its numerous ornamentals in cultivation and for the **opium poppy (*P. somniferum* L.)**, whose capsules are the source of morphine ($C_{17}H_{19}O_3NH_2O$) and other derivates such as codein, laudanum, and protopine. The seeds of this plant are also a familiar condiment in rolls and other culinary products. Opium poppy is locally naturalized in many parts of this country.

The best known native species is probably **mission poppy (*Papaver californicum* A. Gray)**, which would be the true California poppy had not that State's official flower *(Eschscholzia californica* Cham.) usurped the name. Mission poppy is a slender annual herb, 1 to 2 feet high, with the petals about ¾ of an inch long, brick red with a green spot at base, the fruiting capsules about ¼ of an inch long. It has a spotty distribution in open woods at lower elevations of the Coast Ranges of California, especially toward the south, and may be locally abundant in burns the year following a fire. Its forage significance requires further study.

Creamcups (*Platystemon californicus* Benth.) is an annual, growing between elevations of about 1,000 and 5,000 feet, often in sandy soils, in foothills, plains and arroyos from Coos County, southwestern Oregon, to northern Lower California and, inland, to southern Nevada, southern Utah, and Arizona. It was originally discovered by David Douglas (of Douglas-fir fame). The plant is 3 to 12 inches high, spreading or erect, with linear, largely basal, and somewhat hairy leaves.

The almost leafless flower stalks are 2 to 10 inches high, each with a single flower. There are 3 sepals, 6 cream-colored or yellowish petals, in two series, ¼ to nearly 1 inch long, withering but more or less persistent over the fruit, and numerous stamens with flattened and somewhat petallike stalks *(filaments)* from which the scientific name *Platystemon* (from Greek *platy-*, flat, + *stemon*, stamen) derives. The peculiar fruit, likened by some to an ear of corn, consists of 6 to numerous carpels or follicles, becoming jointed and beadlike *(moniliform)* when ripe, and adhering in a rounded, cylindrical mass.

The plant has entered ornamental cultivation and appears to have no forage value but, because of its relationships, perhaps should be regarded as somewhat poisonous. Jepson *(104,* v. *1: 553–557. 1922)* has an interesting discussion of the great variability of this species which has led some botanists to separate it into a great number of species.

Windpoppy [*Stylomecon heterophylla* (Benth.) G. Taylor, syn. *Papaver heterophyllum* (Benth.) Greene] is a slender, yellow-juiced, erect annual herb, with pinnately divided leaves having divisions varying from narrowly linear to oval. The leafy stems, up to 2 feet high, bear showy, brick-red or apricot-colored flowers, 2 inches or more across, nodding in bud, with 2 sepals and 4 petals with a dark spot at the base, blooming April to May. The plant ranges in semishaded woodland types, foothills, dry valleys, and

meadows at rather low elevations from Lake County, California, to Lower California.

There appear to be no observations of domestic livestock eating this plant, which sometimes becomes a pest in grainfields. The scientific name *Stylomecon* derives from Greek μύκων (poppy) + στυλος (Pillar or post—hence style), referring to the distinct (though short and slender) style which bears the headlike stigma. The genus differs from the closely related poppy genus *(Papaver)* in that is has yellow juice, a wholly different pistil, and an absence of the poppy "nightcap" on the fruits, which split open when ripe by valves from the top.

FUMITORY FAMILY (FUMARIACEAE)

This small family, of annual, biennial or perennial, mostly delicate herbs, is represented in the 11 Far Western States by 3 genera and 19 species. Some botanists prefer to regard it as a subfamily of the poppy family, from which it differs in its usually more watery and less milky (but apparently always more or less alkaloidal) juices; alternate or basal, uniformly dissected, often bluish leaves; irregular flowers (mostly in racemes or spikes) with 2 small, often scalelike sepals and 4 more or less united petals in 2 series, the 2 lower or outer ones spurred or saclike at base, the 2 smaller inner petals crested and united over the stigma; stamens 6 (instead of numerous) in 2 series of 3 each opposite the larger petals and the fruit usually a 2-valved, several-seeded capsule, the seeds mostly black and shining.

With the exception of a few species involved in stock poisoning, the family has very limited range significance. Many species have attractive flowers and foliage and are cultivated as ornamentals. The Old World **fumitory (*Fumaria officinalis* L.)**, formerly an official drug plant, has limitedly escaped and become naturalized in this country, and occasionally is observed on western range lands. *Fumaria*, unlike other fumariaceous genera, has small rounded, 1-seeded, nutletlike fruits.

Corydalis *(Corydalis,* syn. *Capnoides)*

Depending on taxonomic viewpoint, there are possibly 11 species of this genus in the Far West. Ownbey *(148)*, however, reduces six of these to subspecific rank. Two other species enter Alaska, one from eastern Asia and another from eastern North America; moreover, several other eastern species enter the fringe of the range country in Texas, Kansas, Nebraska, and the Dakotas.

Corydalis (from Greek κορυδαλλις, the Old World crested or horned lark, *Alauda cristata*—referring to the crested seeds) is conserved under the International Code against the pre-Linnean *Capnoides* (meaning "smoky" in Greek, alluding to the curious, snakelike odor of some species and perhaps the smoky color of the foliage) of Tournefort and some later authors. The genus contains annual, biennial or perennial, erect, or climbing herbs. The yellow, white, pink, reddish, or purplish flowers are borne in racemes, the four

petals unalike, the outer pair spurred at the base, the inner pair keeled on the back. The fruits are somewhat elongated, linear, or oblong capsules with crested seeds.

Some species of *Corydalis* appear to furnish a limited amount of forage in certain sections, but generally they are not sufficiently abundant or palatable to have significance. Moreover, until more knowledge is obtained, it may be safest to regard them with some degree of suspicion because of the alkaloids they contain. One range species, fitweed corydalis (*C. caseana* A. Gray), is known to be a stock-poisoning plant. About 25 Old World and American species are in ornamental cultivation.

Golden corydalis [*Corydalis aurea* Willd., syn. *Capnoides aureum* (Willd.) Kuntze] is the most widespread and commonest of our species, ranging from Quebec to Pennsylvania, Illinois, Minnesota, Missouri, Texas, thence west to Modoc County, northern California, and north, through Manitoba, Saskatchewan, Alberta, and British Columbia, to Yukon and Alaska. It is a low and often spreading winter annual or biennial, with a rather slender taproot, the stems branching from the base, slender, 3 to 14 inches long, the herbage rather pale, grayish, or bluish.

The inflorescence is in loose, terminal, short and mostly few-flowered racemes, the individual flower stalks *(pedicels)* short, slender, and bent downwards in fruit. The flowers are golden yellow, about ½ inch (12 to 15 mm.) long, their spurs typically less than a third the length of the entire flower. The fruiting capsules are spreading or drooping, about ½ to ¾ inch long, when dry, often constricted between the seeds *(moniliform)*, giving a bead-string appearance; the seeds are only obscurely net-veined *(reticulate)*.

Golden corydalis occurs in a variety of sites, dry rocky woods, damp thickets of the ponderosa pine and Douglas-fir types, lower bunchgrass and sagebrush types, cinder soils overlaying adobe, etc., and frequently on limestone soils. It flowers sometimes throughout the growing season, but mainly from late March to July. It occurs at elevations up to about 8,300 feet in Montana and 10,000 feet in Colorado and Utah. The herbage has a somewhat pungent taste; it is often not touched by stock or, if grazed, the palatability rates poor or at best fair. Spanish-speaking people call it "altamisa" and often indicate that it has medicinal properties.

Mountain corydalis [*Corydalis aurea* ssp. *occidentalis* (Engelm.) G.B. Ownbey, syns. *C. montana* Engelm., *Capnoides montanum* (Engelm.) Britt.], treated in many of the manuals as a distinct species, does not greatly differ from the typical form of the species. It has stouter racemes, mostly larger flowers with longer spurs, and stouter, more curving, erect or ascending fruits; the spurs are nearer ½ than ⅓ of the corolla length, and the sepals average 0.5 to 1 mm., rather than 1.5 to 2 mm. long. It has, however, an exclusively western range, from the Black Hills of southwestern South Dakota south, through extreme western Nebraska, Kansas and Oklahoma, to Texas, northern Mexico, Arizona, eastern Ne-

vada, Utah, and southern Wyoming. Usually of too limited occurrence and abundance and of too low palatability to have range importance.

Fitweed corydalis or fitweed [***Corydalis caseana* A. Gray**, Syn. *Capnoides caseanum* (A. Gray) Greene],[46] typically confined to California, is perhaps the most important species of the genus from a range standpoint because of its toxicity. It is a handsome plant, sometimes more than 3 feet tall, with 3 to 5 large, fernlike stem leaves, the herbage bluish *(glaucous)*. The fragrant, white cream-colored or pinkish flowers, often 50 in number, are in thick larkspurlike and spikelike clusters, the inner petals tipped with purple or deep red. The shiny black seeds are relatively large (2.5 mm. long) and only faintly warty under a lens.

This species occurs in the Sierra Nevada Mountains at elevations mostly between about 3,500 and 6,500 feet, flowering largely in late June to July. It is eaten chiefly by livestock in dry seasons. One collector on a California naitonal forest reported: "Seems to be palatable to both cattle and sheep. Recent feeding tests to cattle and sheep at the Nevada Agricultural Experiment Station show that the plant is highly toxic. Over 400 sheep poisoned on the Settlemeyer sheep allotment on Emigrant Creek." Fleming, Miller, and Vawter *(74)* have published a report on the plant. The common name "fitweed" applies to the convulsions characteristic of poisoned animals.

Ownbey *(148)* recognizes four subspecies of *Corydalis caseana:*

(1) **Utah corydalis** [***C. caseana* ssp. *brachycarpa* (Rydb.) G. B. Ownbey,** syns. *C. brachycarpa* (Rydb.) Fedde, *Capnoides brachycarpum* Rydb.] of northern Utah, with conspicuously broad and rounded wing tips of the upper petals.

(2) **Brandegee corydalis** [***C. caseana* spp. *brandegei* (S. Wats.) G. B. Ownbey,** syns. *C. brandegei* S. Wats., *Capnoides brandegei* (S. Wats.) Heller], a tall plant (sometimes more than 5 feet high) of Colorado and northern New Mexico, named for its discoverer, a well-known civil engineer and botanist of California and Colorado.

(3) **Cusick corydalis** [***C. caseana* ssp. *cusickii* (S. Wats.) G. B. Ownbey,** syns. *C. cusickii* S. Wats., *Capnoides cusickii* (S. Wats.) Heller], named in honor of its discoverer, William Conklin Cusick (1842–1922), well-known botanical collector of eastern Oregon. This subspecies has broad-margined upper petal tips and occurs in northeastern Oregon and south and central Idaho.

(4) **Idaho corydalis** [***C. caseana* spp. *hastata* (Rydb.) G. B. Ownbey,** syns. *C. hastata* (Rydb.) Fedde, *Capnoides hastatum* Rydb.], a northern Idaho subspecies, growing up to 6 feet tall, with broadly triangular leaves and much-branched inflorescence. The economic status of these four subspecies needs further study.

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[46] *Corydalis caseana* is named after its discoverer and first collector, Eliphalet Lewis Case (1843–1925). Case, a native of Ohio and veteran of the Civil War, later moved to California; he was an ardent amateur botanist and a close associate of the well-known California botanist John Gill Lemmon (*56*).

In the meantime, it is doubtless safest to suspect them of being toxic.

Scouler corydalis [*Corydalis scouleri* Hook., syn. *Capnoides scouleri* (Hook.) Kuntze][47] occurs on Vancouver Island and the Olympic Peninsula of Washington south to Tillamook County, Oreg., in shady woods and other moist-wet and cool coastal or near coastal habitats from near sea level to about 3,500 feet. It is a perennial from a thickened, somewhat tuberlike root, the stout stems, with about 3 leaves, up to 40 inches high. The compound leaves are less finely dissected than those of most corydalises, the ultimate segments or leaflets being oblong or elliptic, about 1 inch long.

The flowers which, except for the color, somewhat suggest those of larkspur, are in a narrow, rather loose raceme, rose colored, or pinkish, the hood of the spur petal crested but not winged or reflexed, the spur stout, straight, ascending, ½ inch or more long—much longer than the body of the petal itself. The stigmas are more or less triangular, about as long as broad. The fruiting capsules are egg shaped or oblong, about ⅜ of an inch long, with relatively large seeds (about ⅗ mm. in diameter) minutely warty under a lens. The flowering period is from about mid-April to early July. The plant is handsome and is in ornamental cultivation. More data are needed regarding its status as a forage plant. Until more is known about this, it may be safest to suspect it of being toxic.

Bleedingheart (*Dicentra,* syns. *Bikukulla, Bicuculla*)

Dicentra[48] is a group of smooth, often handsome berbaceous plants, with watery juice, perennial from small tubers, ricelike grains, or rootstocks. The leaves are compound or dissected, basal or alternate on the stems. The attractive flowers, in racemes or panicles, are often flattened and somewhat heart shaped, with 2 very small sepals and 4 petals, the 2 outer petals spurred or saclike at the base, the 2 inner ones much narrower; there are 6 stamens. The fruit is an elongated 2-valved capsule. There are 7 or 8 species in the Far Western States.

These plants are not normally palatable to domestic livestock. However, early in the spring when palatable vegetation is scanty or absent and the ground is very moist, their more or less poisonous roots are likely to be pulled up and eaten. At least one species, Dutchmans-breeches, has a record of poisoning livestock. Accord-

[47] Originally collected by David Douglas and his companion Dr. John Scouler (1804–71) near the mouth of the Columbia River on their first journey to western North America; named for the latter by the eminent British botanist William Jackson Hooker (1785–1865).

[48] *Dientra* Bernh. (1833) is conserved over *Bikukulla* Adans. (1763) under the International Code. The generic name is derived from the Greek prefix δι-, two, + κέντρον, sharp point, peg or spur, referring to the two spurs of the outer petals. The synonymous name *Bikukulla,* often written in the Latinized form *Bicuculla,* has a similar significance, being based on the Latin prefix *bi-,* two + *cucullus,* hood. Actually *Bicuculla* Borckh. (1797) is a synonym of the conserved name *Adlumia* Raf. (1808) of this same family.

ing to Youngken *(216)* the rootstocks of **squirrelcorn [*Dicentra canadensis* (Goldie) Walp.,** syn. *Bikukulla canadensis* (Goldie) Millsp.], a northeastern species with heart-shaped, round-spurred flowers, have been used in medicine as an emetic and stimulant. A number of the species are cultivated as ornamentals, especially the **common bleedingheart [*D. spectabilis* Lem.].**

Gold-eardrops [*Dicentra chrysantha* (Hook. & Arn.) Walp., syn. *Bikukulla chrysantha* (Hook. & Arn.) Coville] is found on dry gravelly hillsides, chaparral and chamise types, arroyos, burned-over brush fields, and the like, from Lake County, California, to northern Baja California, mostly in the Coast Ranges, and between elevations of 1,000 and 5,000 feet. It is a pale, bluish *(glaucous)*, leafy-stemmed perennial, 2 to 5 feet high, from a thickened root. The finely compound leaves have rather sharp-tipped ultimate segments. The golden or sulfur-yellow flowers, with an unpleasant odor, are about ⅝ of an inch long, in a rather loose, erect, narrow, elongated panicle. The plant is in flower from about late April to early July and in mature fruit in August and September. More data are needed regarding its forage significance (if any). It is in ornamental cultivation.

Dutchmans-breeches [*Dicentra cucullaria* (L.) Bernh., syn. *Bikukulla cucullaria* (L.) Millsp.] (fig. 47) occurs from eastern Quebec and Nova Scotia south to North Carolina and Alabama, and west to Arkansas, Missouri, Kansas, Nebraska, and Minnesota. Dutchmans-breeches is often called "little staggerweed"; other common names include "little boy's breeches," "white hearts," etc. The plant usually grows in rich moist woods, often near running water, and mostly as scattered specimens but sometimes in abundance. It ranges from elevations near sea level to 4,500 feet.

Dutchmans-breeches is an attractive, smooth, delicate plant perennial from a kind of scaly fleshy bulb composed of the triangular persistent bases of former leaves and small granular bulblets the size of rice grains. The finely dissected leaves are basal, divided into three main divisions *(ternately decompound)*, the ultimate segments fine, linear or of a lance-shaped type, usually with a bluish *(glaucous)* cast. The naked flower stalk is 5 to 12 inches high, with an often 1-sided raceme of white or whitish, sometimes faintly pink (or tinted at the top with yellow or cream color) flowers, ½ to ⅔ of an inch long, the 2 outer petals spurred and the 2 inner petals with small crests. The fruit is a 1-celled, spindle-shaped capsule opening to the base by 2 valves, containing 10 to 20 crested seeds.

As a rule the plant is too sparse a constituent of the range forage crop to be of any importance. However, it is one of the earliest plants to appear. Because sheep sometimes seem to relish it in the spring, they should be closely watched where it is abundant. The plant contains at least three alkaloids, one of which is protopine *(71)*. Protopine ($C_{20}H_{19}NO_5$), a white crystalline powder insoluble in water, is a constituent of opium and there seems to be little, if anything, on record as to its precise physiological action.

Eggleston *(63)* found the plant to be poisonous to cattle in the mountains of southwestern Virginia and states that "most of the

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FIGURE 47.—Dutchmans-breeches [*Dicentra cucullaria* (L.) Bernh.]. An attractive ornamental perennial herb of the fumitory family. Widely distributed in the United States. Poisonous to domestic livestock.

poison seems to be in the bulbs which are commonly lifted with the foliage by cattle but left in the ground by nibbling sheep." Youngken *(216)* mentions that the tubers of both *Dicentra canadensis* and *D. cucullaria* contain the alkaloids corydaline and bulbocapnine as well as fumaric acid and have been used medicinally as an alterative, diuretic, and bitter tonic. Black, Eggleston, et al. *(24)* rate Dutchmans-Breeches as "normally unpalatable" but still highly poisonous."

In the Far West, in Washington, Oregon, and western Idaho, occurs the so-called ***Dicentra cucullaria* var. *occidentalis* (Rydb.) Peck** [syns. *Bikukulla occidentalis* Rydb., *D. occidentalis* (Rydb.) Fedde], perhaps especially typical east of the Cascade Mountains of the Columbia River basin and of the Blue Mountains region. Despite the geographical gap between the typical form and the variety, they appear to intergrade. The var. *occidentalis* typically is reported to have somewhat less finely dissected leaves; the flower spurs somewhat larger and more spreading, and the crest on the inner petals rather more prominent; the rootstock very short, not scaly, and the rice-grain little tubers perhaps more numerous.

Pacific bleedingheart [***Dicentra formosa* (Andr.) DC.**, syn. *Bikukulla formosa* (Andr.) Coville] occurs in the Coast Ranges and Cascades, from British Columbia to Oregon and south, both along the coast and in the Sierra Nevada Mountains, to California. The species is very closely related to **fringed bleedingheart** [***D. exima* (Ker) Torrey**] of the eastern Allegheny and Appalachian Mountains. It is a smooth perennial herb from thickish, creeping rootstocks, the practically naked flower stalks 6 to 20 inches high—surpassing the leaves.

The leaves, basal or nearly so, are compoundly dissected (twice or thrice *ternate*), somewhat suggesting those of a ligusticum, with a bluish bloom *(glaucous)*, 6 inches or more broad, the ultimate segments mostly oblong and pinnatifid. The rose-colored or pink flowers are in terminal panicles, heart shaped as in the commonly cultivated bleeding heart of Japan *(Dicentra spectabilis* Lem.) the 4 petals united to above the middle, the 2 inner petals larger and with short spreading tips. The species is illustrated in Jepson's and Abrams' floras *(104, 2)*.

Pacific bleedingheart occurs in moist woods, especially along streams, between elevations of about 1,000 and 8,500 feet, mostly in rich loams but sometimes in granitic washes, serpentine clays, etc. Under Douglas-fir and other dense stands, it tends to have a slim form. The flowering period varies from early May to August or even early September, depending on altitude, latitude, slope, and seasonal climatic conditions. The plant's distribution is rather wide but the abundance is mostly scattering and local. In most places the species is regarded as unimportant or worthless as a range livestock forage. It has been reported that on the Olympic National Forest (Washington) "elk are very fond of this plant."

There appears to be no record of Pacific bleedingheart poisoning domestic livestock. However, Black, Eggleston, and Kelly *(25)* report that it contains protopine and is potentially harmful; in experimental work with mice, respiratory paralysis and death resulted. Pacific bleedingheart is sometimes cultivated as an ornamental; in fact the original description of the plant by Andrews was based on cultivated specimens grown in England in 1797. The species is more or less medicinal. Schneider *(180)* states of it: "Said to be tonic, diuretic and alterative; extensively used by the eclectics."

While too small and evanescent to have any practical importance,

steershead [***Dicentra uniflora*** **Kellogg,** syn. *Bikukulla uniflora* (Kell.) Howell] perhaps is worthy of mention because of its rather wide distribution, commonness, and unique appearance. It is found an open sites in the mountains, varying from dry to moist, in deep soils and also in shallow, gravelly, or scabby areas, largely in aspen, spruce and weed types, from Washington and Idaho to Wyoming, Utah, Nevada, and California. It is a stemless (*acaulescent)* perennial from a cluster of thickened, spindle-shaped roots; offsets or runners frequently develop from these roots, bearing starchy, spindle-shaped tubers.

The leaves are all basal, about 3 or 4 inches long, slightly and minutely hairy, twice or thrice divided into 3's, with oblong ultimate segments. The naked flower stalks, about 4 inches long or less, bear a solitary, flesh-colored or pink flower about $\frac{5}{8}$ of an inch long, the 2 outer petals strongly recurved, giving the characteristic steershead appearance. The flowering period is mostly from April to June but occasionally may extend into August. The flowers last only a day or two and, with species of ***Claytonia*** and ***Orogenia,*** are among the earliest to appear on the range. Because the plant, if not in bloom, is so easily overlooked, the species is probably commoner than is ordinarily supposed.

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